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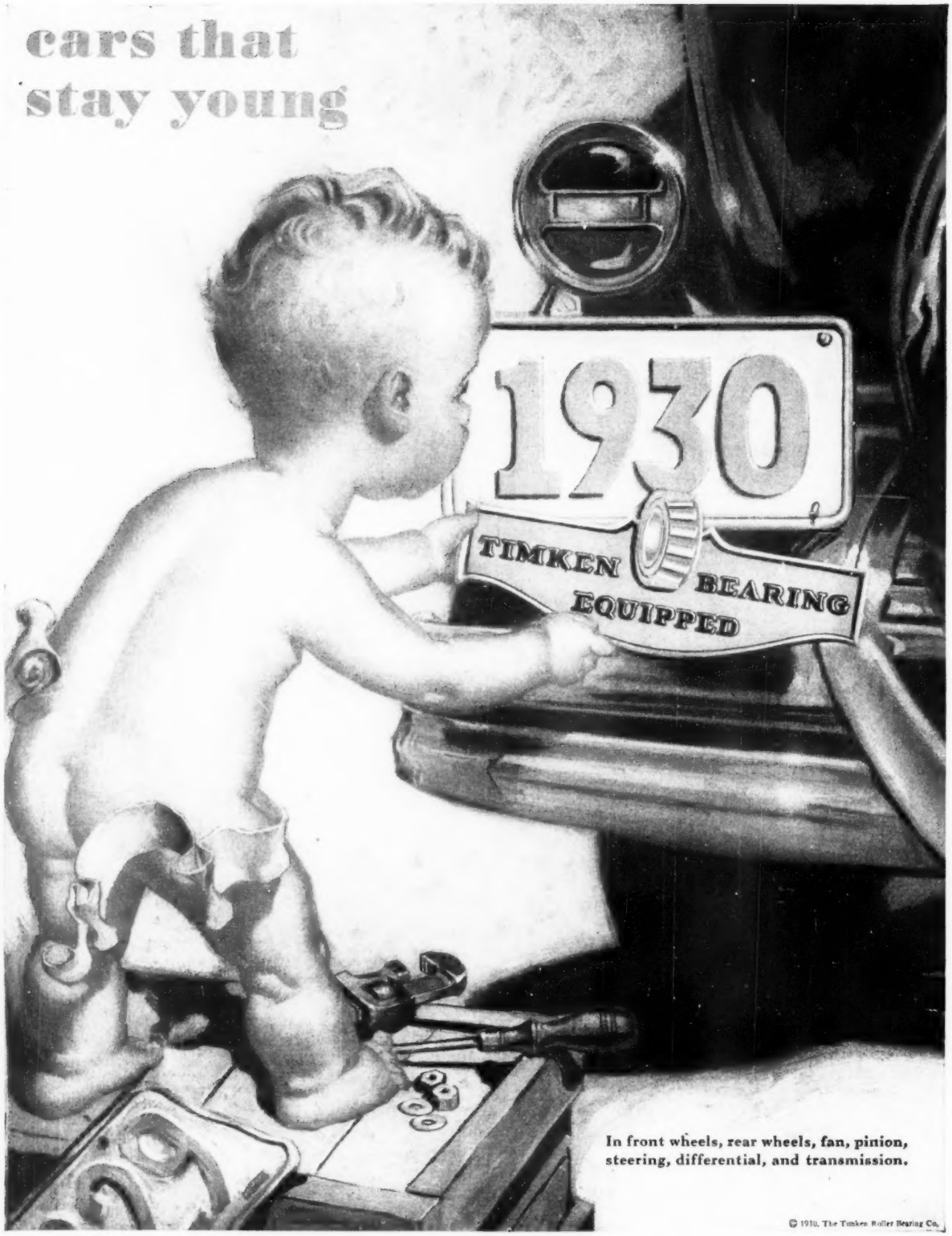
cars that stay young



In front wheels, rear wheels, fan, pinion, steering, differential, and transmission.

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LINCOLN:
HIS PATH TO THE PRESIDENCY
By DR. ALBERT SHAW

THE hates, the ambitions, the struggles, the beloved causes, the forgotten victories of the greatest men in this country's history are now brought to life for you in two volumes containing 500 contemporary cartoons and other illustrations—the vivid pictorial expression of the time.

Hidden away for years because of their biting ridicule — some of these cartoons are now published for the first time. For a quarter of a century, Dr. Shaw personally and with the aid of his staff at the *Review of Reviews* has been engaged in assembling these extraordinary political caricatures — years of laborious search, volumes of correspondence, exploring missions to various parts of the country and finally the painstaking arrangement of a mass of material to give you an accurate, closely related account in picture.

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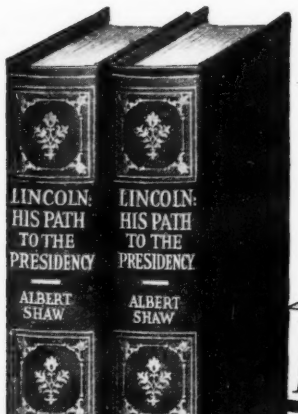
Nothing can bring back the fire and vividness of those dangerous days like this brilliant array of cartoons — *made by artists of Lincoln's time, about the men and issues of his time, for the people of his time.* It is your privilege to have the years rolled back, to see and possess these stirring pictorial souvenirs, to have them accurately interpreted by the splendid text of Dr. Shaw. This is your chance to own a first edition of one of the most unusual books ever published.



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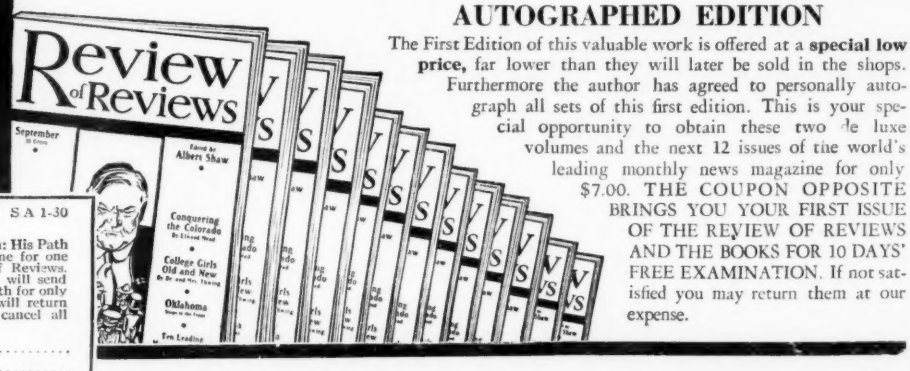

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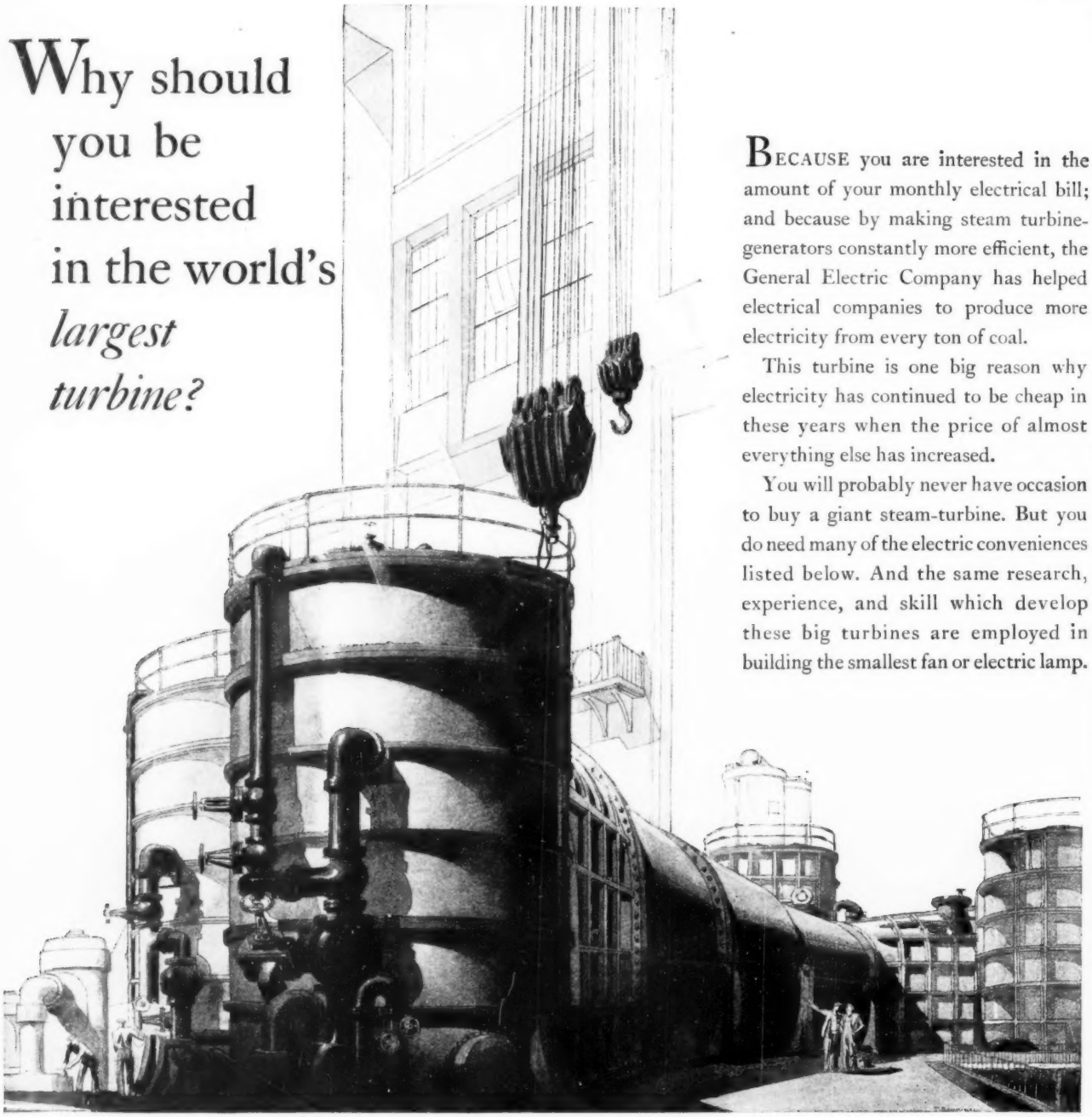

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24 WEST 40th STREET — NEW YORK CITY

January 1930 — *Edited by ORSON D. MUNN* — *Eighty-sixth Year*

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COVER

When cars are driven under their own power from assembly plant to dealer, the motor is occasionally abused before it reaches the buyer. Our cover, painted by Howard V. Brown from information supplied by the Nucar Forwarding Corporation of Trenton, New Jersey, depicts a special truck and trailer arrangement which permits shipment in one unit of from four to six new cars directly from the assembly plant to the dealer, without even starting the new motors.

499902

The Universe Around Us

By Sir James Jeans,
Cambridge University

WRITTEN in a style the average man can understand, Sir James, while recognized as one of the most famous and ablest cosmological thinkers, is able to enhance his subject and fascinate the reader by his presentation. Other scientists readily concede his ability in this line as well as his standing in science. This work will stir profound thought in the reader who likes to think; its scope is as broad as the universe, extending from microcosm to macrocosm.

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By A. A. Knowleton, Ph. D.

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A History of Mechanical Invention

By A. P. Usher
Asso. Prof. Economics, Harvard

IT is a curious fact that this branch of the Arts has fewer histories or records of accomplishment than any other. Yet it is a fact that this is one of only three works of importance—one at least of which has been out of print for many years. Realizing this fact the author ably supplements the others. $5.00 postpaid

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Looking Ahead *With the* Editor

Needed: A Bigger Merchant Marine

IN an article soon to be published, E. M. Herr, Vice-chairman of the Board, Westinghouse Elec. and Mfg. Co., discusses the vital relationship between ships and American prosperity. He says that we have been "slipping back into our old position of almost complete dependence on foreign ships for handling our seaborne commerce," and urges development of wider markets, the building of more ships to handle our commerce, and public support of a bigger merchant marine.

How Old Is the Earth?

BY measuring the rate of decay of radium contained in Yellowstone Park geysers, scientists have estimated the time that has elapsed since ice extended down to these geysers during the Great Ice Age. In a like manner, uranium, which has a much slower rate of disintegration, may be used to estimate the age of the earth's crust wherever it is present. You may read of this interesting and valuable research in an early issue.

Another "Lost City of Nevada"

SCIENTISTS feel confident that many secrets of ancient Pueblo Indians lie buried in the earth of southeastern Nevada. At Mesa House, relics and artifacts tell a mute and colorful yet pathetic story of how these peace-loving Indians lived, worked, progressed, held their own against warlike tribes by building on plateaux, and finally surrendered to superior strength. Look for the coming story on Mesa House.

Vastly Improved

THE Chicago Civic Opera House and Civic Playhouse, recently completed, is said to have the finest mechanical stage equipment of any house of its kind in the world. A forthcoming article will describe its entirely new lighting system which is so arranged that the lighting director can view lighting effects from a concealed position, its hydraulically operated traps and bridges, and, in fact, all its excellent features.

Running Horses

WHO really invented the "movies?" Few people, even among those who have a hazy notion that running horses had something to do with the invention, would connect the name of Leland Stanford with the early experiments. An article ready for release tells of the first "flippack" photograph "movies" made on Stanford's stock farm, the many interesting details of problems encountered, and the later developments.

Every Issue Fully Illustrated

¶ *Read this magazine carefully. If you like it, you will like succeeding issues also. Better make sure of getting it regularly every month. A subscription, costing only four dollars, brings 12 issues to you.*

Among Our Contributors

C. F. Kettering

FEW men today can show a record of achievement in industrial research comparable to that of Mr. Kettering. Born on a farm in Ohio, he was graduated from Ohio State University in 1904, and received a degree of Doctor of Science from the University of Michigan in 1928. Going to Dayton years ago, he organized the Dayton Engineering Laboratories to manufacture Delco starting, lighting, and ignition systems which he invented. A vice-president of General Motors Corporation, he is also an executive in other large companies, and is a member of a number of engineering associations and societies.

William F. Sturm

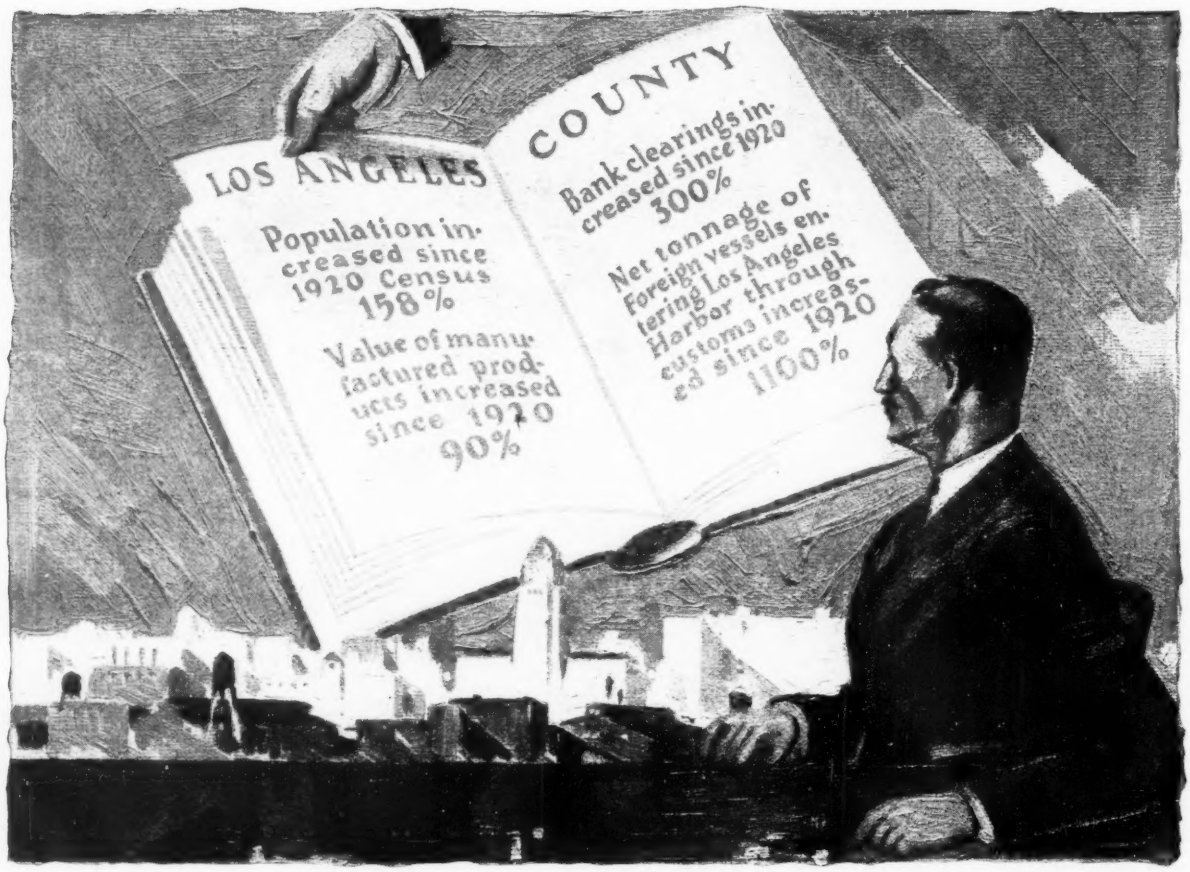
CONVERSANT with the policies and aims of the Indianapolis Speedway since its construction in 1909, Mr. Sturm was a member of the Contest Board up to a year ago. As a writer on racing matters, he has long since won his spurs, having contributed articles to such magazines as *The Saturday Evening Post*, *Liberty*, and others.

Roswell H. Ward

MR. WARD is one of the pioneer advocates of the aviation Diesel engine. For some time he was associated with the former Army Air Service research establishment at McCook Field and with the Curtiss-Wright interests, and has been a prolific and far-seeing journalistic interpreter of the Diesel in its land, sea, and air applications.

Aristid V. Grosse

WE who live on the peaceful side of the globe may find it exceedingly difficult to believe that any serious scientific research could be pursued in war-torn China, yet the article by Dr. Grosse on page 42 indicates that such is an actuality. China is an immense country in which a war or two is easily lost; and Chinese institutions "carry on" in spite of them. Taking occidental scientific thought as its background, the orient is laying the foundations of a future age of science of its own, and—who knows—it may be more brilliant than ours!


LOS ANGELES COUNTY
Population increased since 1920 Census 158%
Value of manufactured products increased since 1920 90%
Bank clearings increased since 1920 300%
Net tonnage of Foreign vessels entering Los Angeles Harbor through customs increased since 1920 1100%

A Record of Development Unsurpassed in History

JUST so long as Southern California continues to enjoy its delightful year 'round equable climate, and other living advantages; and just so long as human nature remains as it always has been . . . people will continue to flock to Los Angeles County.

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Industrialists who are entrusted with the destinies of great manufacturing plants and who must consider the economics of production, distribution and markets, are bound to realize the importance and the good business of locating plants in Los Angeles County to serve this great metropolitan area . . . . and the whole Pacific Coast . . . . and to develop the tremendous virgin export markets of the Far East.

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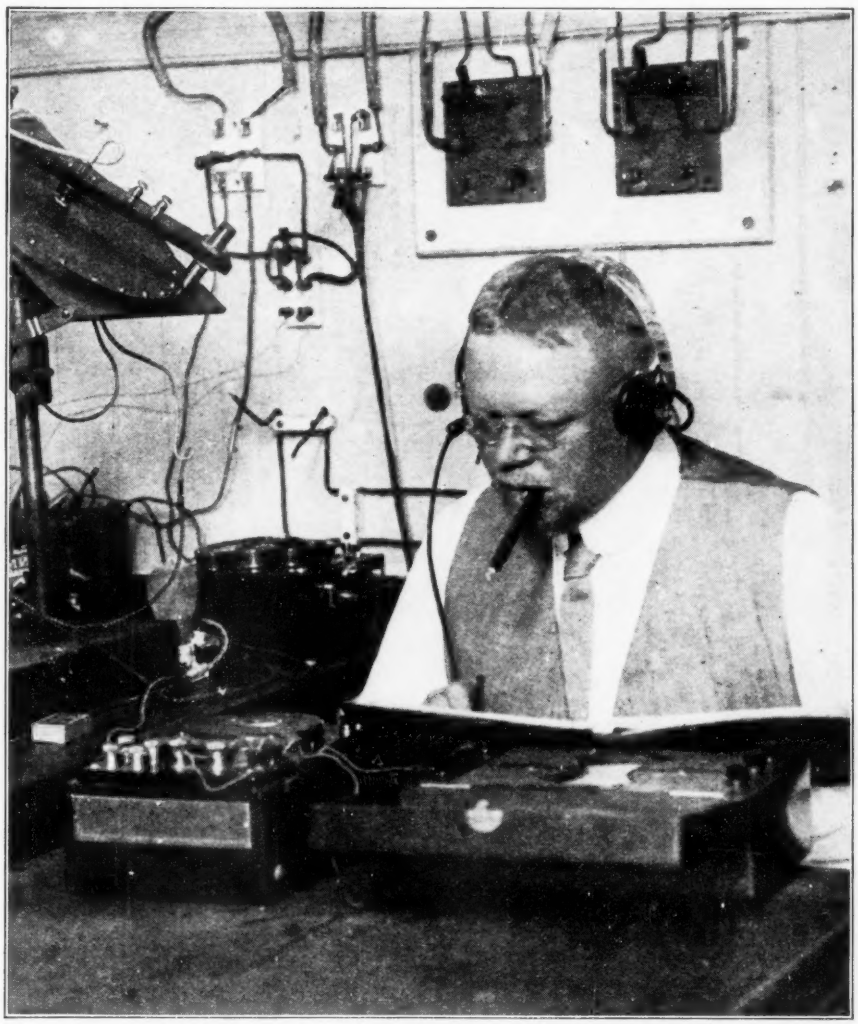


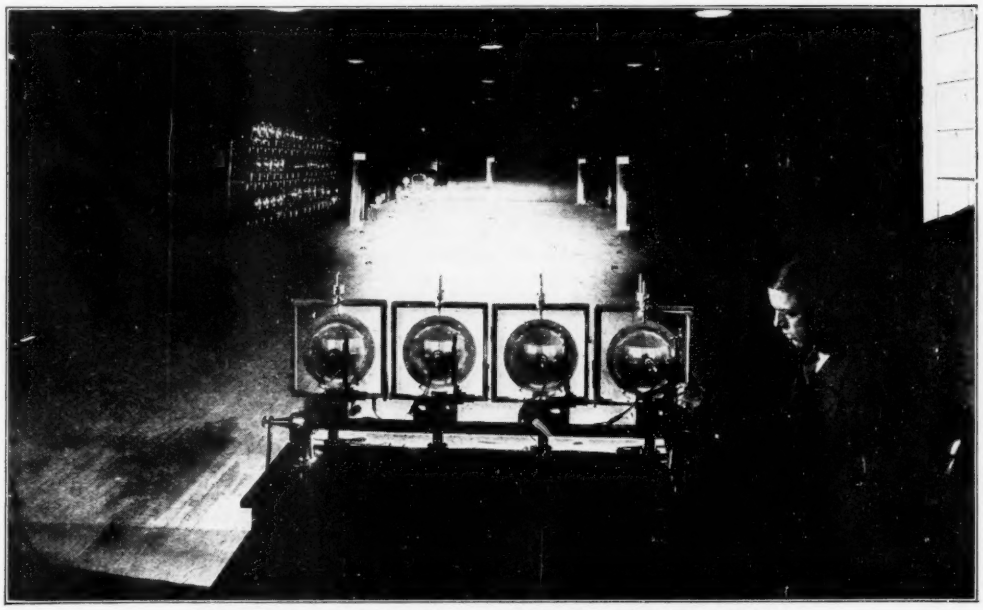
Reginald A. Fessenden

PROFESSOR REGINALD A. FESSENDEN has been awarded the SCIENTIFIC AMERICAN Medal for Safety at Sea by the American Museum of Safety, who appointed an extremely technical committee composed largely of naval officers, captains of vessels, and naval architects. Eighty competitors from 13 countries strove to win the famous gold medal which is so rarely bestowed. Professor Fessenden's achievement in devices for protection to life at sea won overwhelming recognition. Born in the Province of Quebec on Oct. 6, 1866, Professor Fessenden was employed at the Edison machine works in 1886 and 1887 and for three years thereafter was head chemist of the Edison laboratory. Later he was Professor of Electrical Engineering at Purdue University and Western University of Pennsylvania. He was special agent of the Weather Bureau from 1900 to 1902 and general manager of the National Electric Signaling Company from 1902 to 1910. Since then he has been consulting engineer of the Submarine Signal Corporation of Boston. Owing to illness, Professor Fessenden was unable to receive the medal personally at the Union League Club on November 7th, so his son officiated in his stead. Everyone will wish Professor Fessenden a speedy recovery and long life.

James V. Lloyd photograph, Yosemite

Yosemite's Winter Finery

THE cold of winter evenings turns the spray of Upper Yosemite Falls, which has a drop of 1430 feet, into ice that coats the entire cliff face. When the sun strikes this section of the canyon walls, the ice melts off in chunks that accumulate at the base of the falls. The ice piles up during the winter so that sometimes by March 15, the ice talus cone is 250 feet high.



"HOW FAR THAT LITTLE CANDLE THROWS ITS BEAMS"

Unlike Portia's candle, automobile lights must be controlled. Here we have the interior of a headlight testing room where reflector types are tested for glare, strength and direction of beam, height above ground, et cetera. An actual car, in laboratory background, is used here

Research Made Your Motor Car

The Car of Today Is a Vast Improvement Over That of 1920. Constant Research and Development Made It Possible

By C. F. KETTERING*

Vice-President of General Motors Corporation, and General Director of the Research Laboratories

SUPPOSE that ten years ago a brand new automobile, 1920 model, had been sealed up in a glass case. Suppose also that the seal was such a good one that nothing at all has happened to the car with time, but that it is in perfect condition today—not a speck of rust; not a bit of tarnish. The price of the car was 1500 dollars in 1920. What would you give for it now?

Before you decide, look the car over pretty carefully. You will see that it does not have four-wheel brakes, nor balloon tires, nor Duco finish. It is painted all in black, with no relieving color, except for some stripes of yellow. It has no air cleaner, no oil filter, no ventilator in the crankcase, no fuel pump, and no shock absorbers. You should know also that, although the engine is almost the same size as that in the present model of the equivalent make, its power is much lower; the car will not pull hills as well nor run as fast. But then you would not want to drive it so fast anyway, for it does not steer as easily, the engine does not run as smoothly, and the whole car does not ride nearly as comfortably as the up-to-date model does.

*See "Among Our Contributors," page 5.

Now that you know all this, what do you bid for the car? It is safe to say that you would not pay over 500 dollars for it. But why not? This is not a "used" car. It is just as good as it was the day it was made. This car sold readily for 1500 dollars in 1920. Why is it worth only one third as much to you today?

THE answer is that that differential of 1000 dollars is the figure at which you, as a representative customer, reckon the value of the research and the engineering work of the past few years. The difference is not that the early car is any worse today than it was in 1920, but that the present car is so far superior to it that people think it is a thousand dollars better. And in that judgment they are not mistaken.

The National Research Council recently sent a questionnaire to a large number of American manufacturers, asking about their activities in research. An analysis of nearly 600 of the replies received showed that 52 percent of the manufacturers do some industrial research. Now it is certain that, if such a census were taken within the automobile industry alone, the percentage would be much higher. The motor car industry is unique in that *every* manufacturer who expects to stay in the business must be constantly experimenting and improving his product. And therein lies one of the outstanding reasons why the automobile industry has gone forward by leaps and bounds. It is certainly true that so far as the motor car business is concerned there are no park benches for it to rest on. There is only one place where park benches may be found, and that is immediately in front of the undertaker's office.

The opinion is sometimes heard that the yearly bringing out of new and improved models of cars is a bad thing for the public, and therefore for the industry. This opinion was expressed to me not long since by a man who had just been into an automobile sales-room to look at a new model of the car he had been driving.

"I was tremendously impressed with the new car," he said. "It was beautiful. The advance made was quite marvelous. The only thing that made me sore was that they would not allow me within 200 dollars of what I expected on my old car. The thing that you did in bringing out that new model

was to depreciate 200 dollars worth every one of the cars you made last year."

"You are wrong in that," I replied. "Did we put so much as a scratch on the paint of your present car? Did we harm a bearing or score a cylinder? Did we break a spark plug? Did we punch a hole in your gasoline tank between last night and this morning?"

"No, I'll admit that you didn't do any of those things," he answered.

"But you say we depreciated your car to the extent of 200 dollars between yesterday and today," I continued. "No, we did not *de*-preciate your car. What we did was to *ap*-preciate to the extent of 200 dollars' worth your idea of what a car ought to be. All we did was to show you an automobile so far superior to your old one in several particulars that, despite the fact that you are complaining about the allowance on your old car—which, after all, is merely what someone else is willing to pay for it—you are going to buy the new car anyway, aren't you?"

"Sure," he replied.

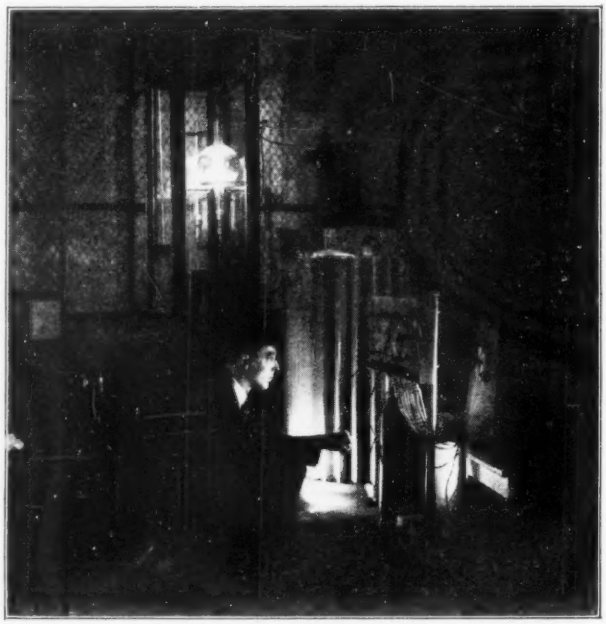
"THEN you have learned that it is worth 200 dollars to have a change of mind," I said. "If we had not elevated your mental idea of what an automobile should be, you would not have bought a new car, would you?"

"No."

"Then, we would not make the new car, the steel mill would not produce the steel, the paint factory would not make the paint, the textile mill would not weave the cloth, the tire factory would not manufacture the tires, the glass mill would not make the glass, the railroad would not haul the freight—and then business would not be so good."

The relationship of industrial research to the automobile is a very intimate one, for it is only as a result of an immense amount of research and experimentation that we have the automobile at all. The motor car is said to have been made possible by three things: rubber, alloy steels, and petroleum. That is the truth, perhaps; but it is not the whole truth, for the scientific and practical developments that have made the up-to-date automobile possible came from a great many sources. Electric lights, for instance, are certainly very essential to the utility of the motor car, even though they do glare at us too much sometimes. But without the single development of ductile tungsten it would not have been possible for us to put electric lights on automobiles.

We all take electric lights on cars and everywhere else as a matter of course. So some of us may have forgotten that the long research conducted by Dr. W. D. Coolidge and his helpers, which resulted finally in the discovery of how to make ductile tungsten wire, was one of the great classics of scientific as well as of practical research. And probably none of us has computed, nor can compute, how much we owe to that one development. Ductile tungsten has meant much to the motor car, because carbon filament lamps were too inefficient to be practical for automobile headlights, and the early tungsten filaments were so fragile that on a moving vehicle they would quickly have shaken to pieces.



DANGER—100,000 VOLTS

A wire cage grounded on pipes is used in automobile research laboratories to shield experiments from electrical disturbances

IT was the search for smokeless powder that constituted the first of the long series of hard-won battles which have made possible the durable and attractive lacquer finishes on cars today. The grandfather of Duco was gun-cotton. One of the principal problems that had to be solved in connection with the use of lacquer finishes on automobiles was that of securing suitable solvents for nitrocellulose, and of providing them cheaply enough and in adequate amounts. This problem was finally solved by the combined efforts of the bacteriologist, the synthetic chemist, and the chemical engineer; but it was not solved without a great deal of patient research.

Many of the essential contributions to the motor car have come out of research and development in other industries apparently remote from it, such as in ceramics, storage batteries, abrasives, synthetic resins, celluloid, glue, pulp products, leather and coated textiles, electro-chemistry, and even such an apparently unrelated thing as the setting of diamonds. The automobile draws upon almost every industry in the country, and upon some of them in a large way. Immense amounts of glass, leather, rubber, lumber, steel, aluminum, copper, tin, lead, zinc, nickel, chromium, cotton, wool, glue, paint, varnish, and goodness knows what are used in making motor cars. The motor car, being the ultimate consumer of many types of manufactured goods, naturally benefits from the research done in the industries that supply it.

If it had not been for just one of the developments in alloy steels, namely, high-speed cutting tools, it would scarcely be possible to make automobiles, or at least it would not be possible to make them as cheaply and as accurately as is done today.

WITH the aid of these tools, the more than 10,000 parts that every automobile consists of can be shaped with the greatest rapidity, and at the same time with the utmost precision. So hardy are these teeth of steel that they tear away on one piece of metal after another at such a terrific rate that they get very hot at the task. But that does not make them one whit the less effective. The finished pieces they turn out so speedily are always "interchangeable." They are every one exactly alike; and, with the exception of just a few pieces, the man who assembles them into the final product need make no selection whatever. Generally he can use one of the pieces just as well as another. And even in the case of those few parts where, in order to get a perfect fit, a selection is sometimes made, the choice lies between parts that differ in size by the fraction of a hair's breadth only.

Anyone who has ever had to "run in on the rim" has a pretty good idea of how large has been the contribution of rubber to the automobile. The slow and bumpy progress that he had to make then was just a little taste of what the automobile would be like without the pneumatic tire, or of what it would be like if he had to run *all* the time on *four* unyielding rims. By making it possible to glide smoothly along on a cushion of air, the rubber tire has done more to make the motor

car a satisfactory and useful vehicle than people usually give it credit for. But the rubber tire is altogether a product of research, of research which has been long and persistently pursued, and which is still being carried on intensively.

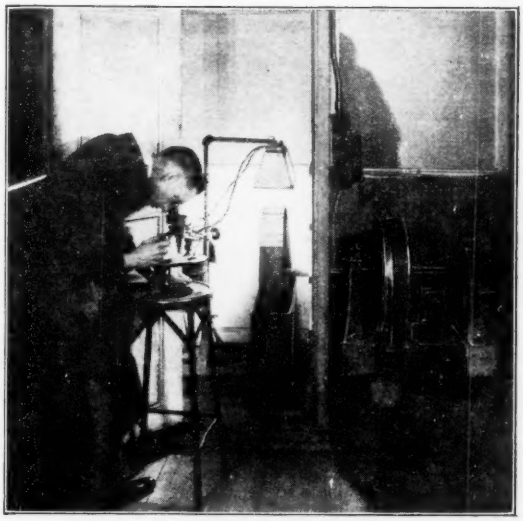
Likewise, it is only as a result of much research and experimentation in the petroleum industry that the constantly mounting numbers of automobiles have been kept on the roads. Research in the geological location of oil deposits has enabled more and more petroleum to be found. But this alone would not have been enough. If the oil refiner had not found out how to make more gasoline out of the petroleum that passed through his refinery than he made 20 years ago, it would have taken nearly four times as much crude oil as it did to yield the gasoline consumed during the past year. It is true that there is plenty of petroleum today. But where would we get four times as much as we consume now?

THE large improvement in yield of gasoline, and the consequent lesser consumption of petroleum per car, came about as the result of an immense amount of research and experimentation, first, on making gasoline by "cracking" heavier oils; second, on extracting gasoline from natural gas and from the gases produced in refineries; and, third, on improving the means of separating from petroleum the gasoline present in it as it is removed from the oil pool. The result of all this research has been that during the past 20 years the amount of gasoline produced from each barrel of petroleum pumped into the refinery has gone up from 4.5 gallons to more than 17 gallons.

In the engineering features of automobiles there has been, of course, an immense amount of persistent experimentation from the very outset. In the matter of engines, for example, constant experiments have been made on the best ways to construct them, on how to lubricate them and to cool them, on improving the balance of engines and the smoothness with which they run, on valves and means of opening and closing them, on shapes of combustion chambers, on means of getting ignition and of controlling it, on carburetion and atomization of the fuel, and on means of equalizing the distribution of charge to the various cylinders.

Much experimentation has also been carried out on such features as transmissions, differentials, axles, brakes, steering gears, and closed bodies. As a result of this constant research and experimentation, the gradual evolution of the automobile has all been toward more useful, more beautiful, and more economical cars, as well as cheaper ones.

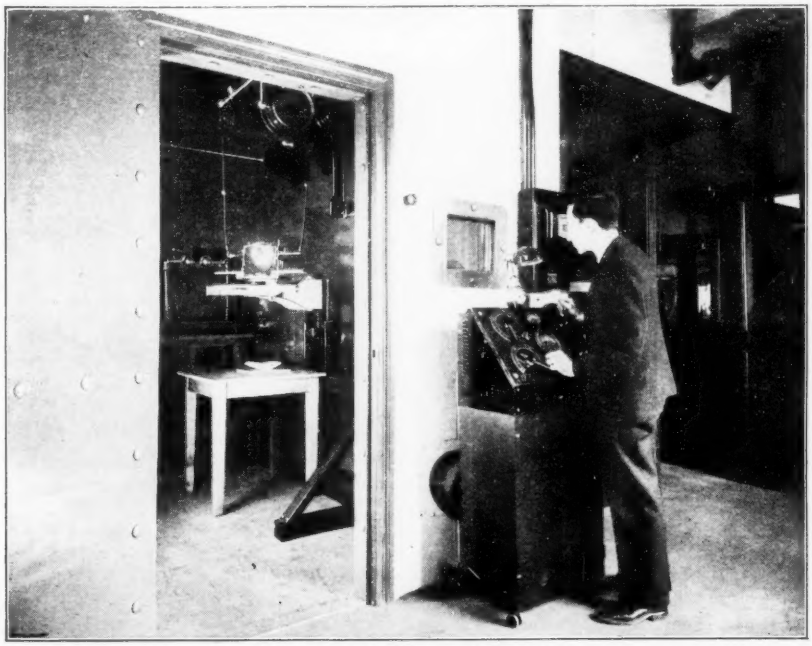
The researches that have resulted in putting a motor car into nearly every American family have not all been confined to the fields of science and engineering. Research, whether it be strictly scientific or both scientific and practical—and it is scarcely ever one without the other—consists simply in getting the facts. In order to make automobiles cheaper and cheaper as well as better and better, it has been necessary to get the facts on materials, engineering, purchasing, manufacturing, sales, service, advertising, and many other things.



DOES IT WEATHER?

A series of lacquered plates passes through water and then under a powerful light to test lacquer weathering

And so the motor car is quite definitely a product of research. It represents a result of the application of scientific and practical discoveries to everyday life. The huge automobile industry has arisen largely through commercial research having acted as a translator of scientific ideas to a traveling public.

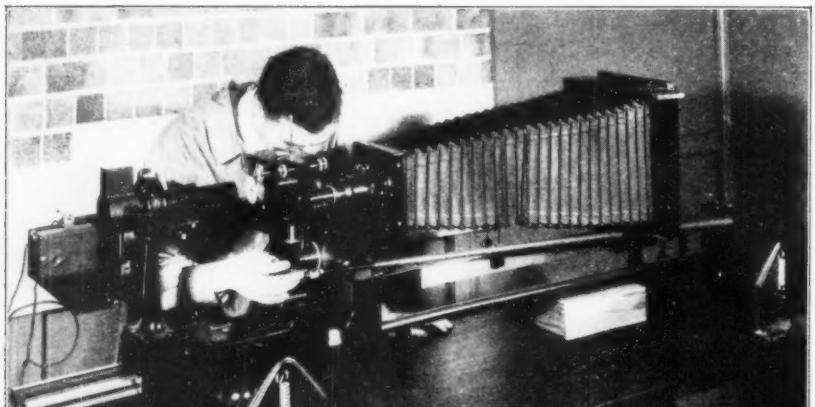


IS IT UP TO THE STANDARD?

At intervals, castings of various parts that are to go into automobiles are examined by means of the X ray. The X-ray room is shielded to protect the operator from dangerous rays

SCIENCE in general needs an interpreter to translate its discoveries into products that are useful to ordinary people, and that is one of the principal functions of industrial research. The general purpose of research in industry is to discover, analyze, and recommend improvements in products and methods, and in the automobile industry there is an immense amount of this kind of experimentation going on. Such experimentation is not what is called fundamental research, but it is research, nevertheless, and a very useful form of research as well.

The results of research that have gone into the automobile have meant much to the ordinary man. The first way in which it has benefited him is in his ability to buy a valuable means of getting about the world, which, if it had not been for the large amount of research and experimentation put into it, he could not possibly have. Twenty-five years ago the man who had an



FOR STRUCTURALLY PERFECT METAL

It is necessary to know the crystalline structure of metals used in the production of finished parts. Here a metallurgist is examining a piece of metal with a powerful photo-microscope

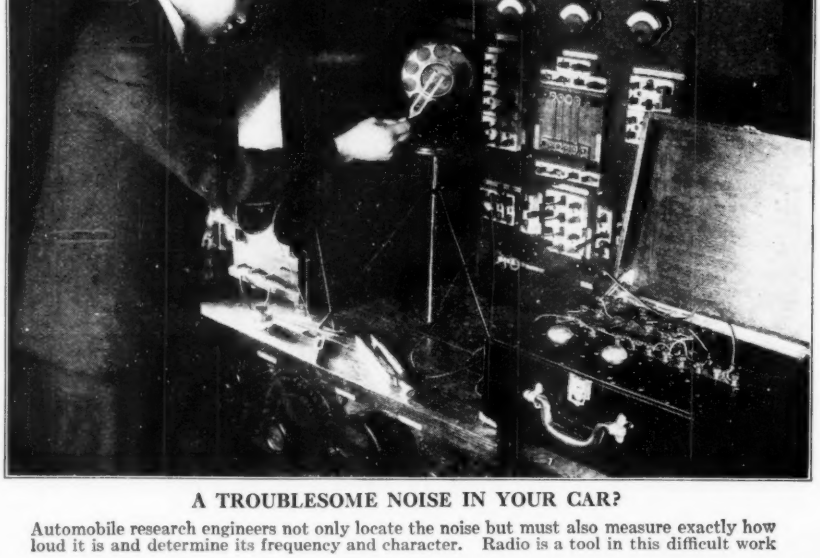
automobile was on a par, from the viewpoint of transportation, with the man who had a chariot 2500 years ago. Now nearly every family has a car, even the worst of which is so far ahead of the ancient chariot—or of the early automobile, for that matter—that the carriage of the ordinary working man is one the like of which the ancient king never even dreamed of having. That the ordinary man today has a multitude of things the ancient king could not command with all his wealth has come about altogether as a result of that persistent experimentation, which of recent years has been organized and called industrial research.

THE second way in which the continual research on the motor car has benefited the ordinary man is in the relatively lower price he has to pay for his automobile than for most other things he buys. Although the cost-of-living dollar is now worth but 62 cents as compared with 1914, the automobile-purchasing dollar on the same basis is worth $1.13. So, as a result of much persistent experimentation and consequent development within the automobile industry, a dollar will go nearly twice as far in the automobile salesroom today as it will on the average in other places where goods are sold. If the cost of cars had been allowed to follow the cost-of-living curve since 1914, the people who bought automobiles last year would have had to pay 3,000,000,000 dollars more for them than they did. This saving does not take into account the marvelous improvement in cars which did not cost the customer anything.

The third way in which the constant experimentation that gave us the motor car has helped people is in the fact that at least one out of every five or six people who now have a job owes it to the motor car. The automobile industry itself either directly or indirectly gives employment to 4,500,000 people. The petroleum industry employs more than a million people, the motor car having caused it to expand 15-fold since 1900. Partly on account of the iron and steel needed for cars, for roads and bridges, and for buildings to serve the automobile, the iron and steel industry has expanded to more than 10 times its size in 1900, so that it now employs about 3,500,000 people. Besides the workers mentioned, there are all those who are employed on railroads, in telephone exchanges, in stores, in offices, in schools, and in fact everywhere, who would not have jobs if it were not for the stimulus that the motor car has given to industry. And remember that, without research, we would not have had the motor car at all.

How much improvement in automobiles will be made within the next ten years? It is impossible to tell exactly, for as the automobile keeps getting better, more and more effort is required to improve it further. But the motor car has not yet reached the final stage of perfection by any means, and more research and experimentation are going on in the automobile industry now than ever before. This research is also better organized than at any time in the past. Hence, there is every reason to suppose that, if one of the best of our 1930 motor cars were to be sealed up in a glass case now, the customer of 1940 would not think it worth any more by the standards which will have been set for automobiles by that time than we today think the 1920 car is worth.

¶ *Of the researches necessary to produce and constantly improve modern cars, the foregoing discusses a varied but principally pre-production class. Elsewhere in this issue, other researches vital to the industry are discussed. The article on page 18 outlines the value to the automotive engineer of the races on the Indianapolis Speedway, the front-drive car described on page 28 having been conceived there. Exhaustive "proving-up" tests of new improvements, such as those discussed on page 46, are necessary. On page 60 are described the researches in gasoline that have made possible the design of higher powered engines and have assured for the motorist fuel of a definite high quality.*—The Editor.



A TROUBLESOME NOISE IN YOUR CAR?

Automobile research engineers not only locate the noise but must also measure exactly how loud it is and determine its frequency and character. Radio is a tool in this difficult work

OUR POINT OF VIEW

Game Bird Laws

ATTACKING the Bureau of Biological Survey for its policies relative to duck hunting seems to have become the favorite indoor sport of certain individuals and a section of the outdoor press. And, unfortunately, their clamor has a quality of apparent plausibility which readily deceives the uninformed.

Recent criticisms of the Bureau by these too-conservative conservationists and sentimentalists might lead us to infer that our water fowl are practically extinct, were our credulity not tempered with judgment. They would have us believe that the only way to save them is to do away with duck clubs and increase other phases of duck-shooting "verbotens." They threaten to force federal legislation to carry their point.

Incongruous with these criticisms is the fact that hunters in various sections report greater numbers of water fowl this year than have been seen before for many years. Instead of nearing extinction, ducks are apparently increasing; and, while we, also, protest *needless* slaughter of them, they are, after all, game birds.

The Bureau of Biological Survey, after sane consideration, may consider justifiable the modification of certain regulations relative to the shooting of these birds. If so, any policy agreed upon by the Biological Survey and its advisory board should be sustained. It has demonstrated its worth and ability as an institution and has gained the confidence and respect of every game department in the United States. We do not believe its policies are now, or ever will be, open to thoughtless criticism, or should be menaced by any clique seeking merely "their way."

We Get Bumped

SUPPOSE one were to request the first half dozen people he encountered to name the most inventive nation. Suppose about six of these half dozen were to reply, "Why, we are, of course—haven't you ever heard of Yankee inventiveness?" And then suppose you were to reply that we rank twelfth among the nations in this particular quality.

Facts are facts, despite the natural bias of all humans in favor of whatever is their own. Professor Mark Jefferson, well-known writer and authority on the distribution of population and on other statistical studies of the human race, has published in the *Geographical Review*, quarterly journal of the American Geographical Society, the interesting outcome of his research on the "geographical distribution of inventiveness." His findings do not flatter our national self love. He has found that the leader in inventiveness is Switzerland. "The facts," he says, "are overwhelming." Switzerland, he adds parenthetically, is a world leader in broader respects than inventiveness, a fact which he attributes largely to that country having long been an asylum which has received thousands of the persecuted intelligentsia of other lands. Such people usually possess the quality of originality, for various manifestations of which they are or were persecuted. Originality finds one outlet in invention.

Getting down to concrete figures Professor Jefferson finds the Swiss people, man for man, more than three times as inventive as the Germans, four times as inventive as the French, five times as inventive as the British, and nearly six times as inventive as we Americans.

It may harm us little in the long run thus to have our complacency bumped. "Yankee inventiveness" is a well established term and in itself it is an accurate one. But the noun is not the exclusive possession of the adjective.

A Worthy Cause

AT the time this issue reaches you, a few days before Christmas, the joyous spirit of the holidays will be upon you, your petty troubles will be forgotten, and the chances are that you will be happy. In the vast majority of homes, gayety, laughter, and song will reign for days, but in a not inconsiderable number where reside the families of men in prison there will be desolation, heartaches, cold, and hunger.

The tremendous social problem of re-making criminals into useful citizens has been too often discussed to necessitate analysis here. We believe, to paraphrase a familiar quotation, that reformation of the criminal begins at home—his home. Kindness shown to members of his family is more likely to touch him than any amount of preaching; and sympathy and aid for them would do more toward inspiring him with hope and courage than the fear of prison bars.

The Volunteer Prison League of the Volunteers of America, Inc., are therefore performing a worthy service in extending practical help and kindly friendship, and in giving warm clothing, money, food, and toys to the families of prisoners. We heartily approve their work and urge that you do what you can to help, especially for the Christmas season, by sending contributions of the nature noted above to the League at 34 West 28th Street, New York City.

Unhealthful Noises

NOISES loud and screeching, noises strident, discordant, sporadic, and unrhythmic—the innumerable, nerve-racking noises of New York City are to be scientifically studied and, if possible, a solution for the problem outlined. The city health commissioner has appointed to perform the task a notable group composed of lawyers, physicians, engineers, builders, and neurologists.

In the sense that this problem has been studied in many places for decades, mainly as a nuisance problem for the police to handle, it is not a new one; but this is the first serious attempt to cope with it as a social problem. Old police regulations had to do with noises of horse-drawn street cars, carts rumbling over cobblestones, peanut-stand whistles, hucksters' cries, piano practicing, and singing. New regulations will have to consider such modern torturers as radio loudspeakers which make both day and night hideous with their cacophony of booms and shrieks from radio stores and a dozen nearby apartments, the riveting hammer, "rheumatic" motor trucks which rattle in every joint, sirens, and the thoughtless motorist who sounds his horn continually.

The influence on human health of the din assailing our ears has not been definitely established but it is generally agreed that insomniacs and neurotics suffer more acutely because of it; and it is logical to assume that it may cause such people to have nervous breakdowns. Likewise, noise may reasonably be said to cause nervousness and insomnia in people otherwise healthy. In either case, the result will be—aside from considerations of the effect of jarring sound waves impinging on the auditory nerves which is yet to be determined—a lowering of the vitality and powers of resistance to disease of the person concerned.

While there is no way of foretelling what results may come of the study now being conducted in New York City, we believe the efforts of the experts will not be in vain. Other urban centers would do well to follow suit in this worthy cause.

Air

About Good Air and Bad—Good and Bad Ventilating Systems. How Certain Not Very Ancient "Scientific" Ventilating Principles Are Already Out of Date

By DONALD A. LAIRD, Ph.D., Sc.D.
Director, Colgate Psychological Laboratory

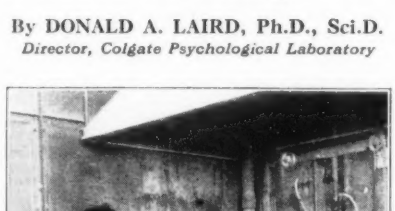
CITIZENS in about half of the United States are forced by law to live in air that is harmful. Recent laws, based upon half formed scientific theories of a century ago, keep hundreds of thousands of Americans breathing and living in air that injures health and diminishes working capacity. Theaters, public schools, and factories in nearly half of the states are required by statues to use systems of ventilation which are not only wasteful in money but in vitality and efficiency as well.

Colds, circulatory disorders, catarrhal conditions, and even digestive disturbances are traced rather directly and surely by scientists to bad air conditions. Air does not contribute to these by carrying germs, for it is well proved that one of the best ways to kill germs is to get them into fresh air. There are no air-borne germs that should be seriously considered. It is something more complicated than simply germs that is responsible for the ill-effects of much of the air with which we are surrounded.

In observations on 5500 school children under different air conditions, for example, it was found that those spending the school day in rooms with temperatures from 59 to 67 degrees had 70 percent fewer colds than pupils of the same age and status who were in mechanically ventilated rooms with a temperature from 68 to 69 degrees. The children with fewer colds were in the colder rooms, and in rooms with only natural window ventilation.

AT a temperature of 80 degrees school children are reported as "restless, dull, and incapable of continued mental effort." At a slightly cooler temperature of 76 degrees they are dull, sleepy, and have poor penmanship. When the temperature is reduced to 70 degrees they are reported as "doing excellent work, and with cheerfulness in class." Best work is reported at a temperature of 68 degrees. When the temperature is lowered to 66 degrees splendid work is still done, but they begin to complain about the cold, while 60 degrees is too cold for good work.

When the room temperature rises above 68 degrees the body becomes feverish, we breathe more rapidly, the heart beats faster, and in a short time



ILLEGAL THOUGH EFFECTIVE

This exhaust hood would be illegal in some states, though it removes the gases

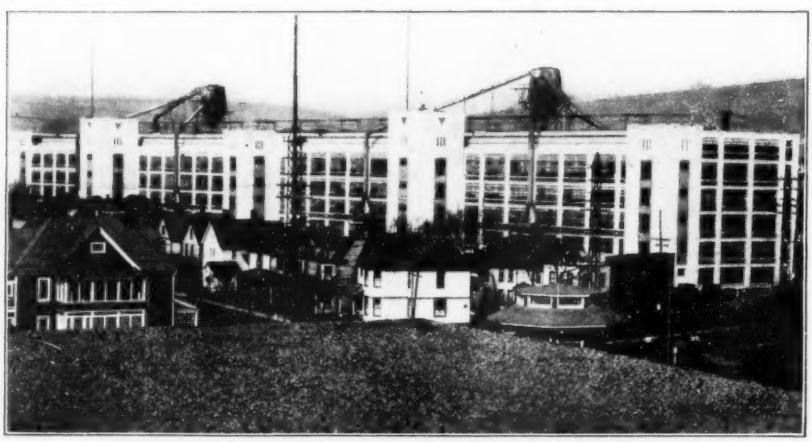
the blood-vessels become weakened. The temperature does not have to rise much above this level for these ill-effects to become apparent. Why, then, is not summer the most hazardous time of the year? The answer which soon will be clear is that, for many, it *is* the most hazardous.

What is there about air that causes all this, and more too? We have seen that it is not germs and bacteria. Are there poisons in the air?

There is the famous and appalling case of the ship *Londonderry* which was bound for Liverpool with 200 passengers on board shortly before the Civil War. They ran into a severe storm and the captain ordered the passengers into the steerage cabin, no larger than an ordinary living room, where presumably they would be safe below decks. Shortly after the episode a writer, Edward Jarvis, described the ensuing events as follows:

"Into this small space the passengers were crowded; they would have suffered inconvenience if the hatches had been left open but the captain ordered these closed, and ordered a tarpaulin to be thrown over the entrance to the cabin and fastened down. The wretched passengers were now condemned to breathe over and over again the same air. This soon became intolerable. Then occurred a horrible scene of frenzy and violence, amid the groans of the expiring and the curses of the more robust; this was stopped only by one of the men contriving to force his way on deck and to alarm the mate who was called to a fearful spectacle. Seventy-two were already dead, their bodies were convulsed, the blood starting from their eyes, nostrils, and ears."

ALMOST a century before the *Londonderry* tradegy another catastrophe of bad air occurred. The Nawab of Bengal has just captured Fort William in Calcutta and his men forced 146 European men as prisoners into a guard room scarcely 20 feet



AIR CONDITIONING AND DUST REMOVING EQUIPMENT

At a plant of the Endicott-Johnson Shoe Company. Modern industrialists install modern protection for workers to get larger output; also because of an enlightened point of view

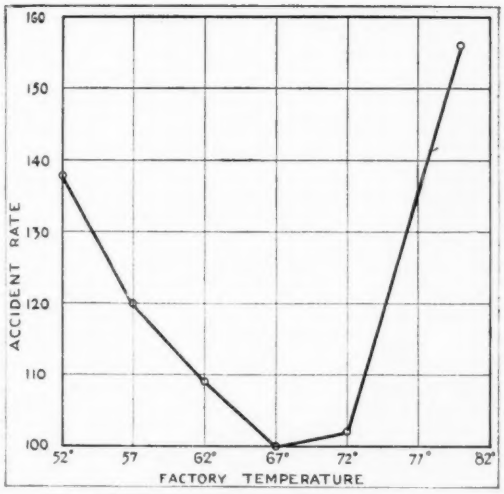
square, provided with only two small, strongly barred windows. A description of the outcome runs:

"Very soon after they were crowded in, an almost incredibly profuse perspiration broke out upon them, which was followed by consuming and increasing thirst. They became furious and goaded their guards with insults to provoke them to fire, in which they failed. They made furious cries for water; a little of it was brought to them in hats and forced through the bars. The stronger forced their way to the window and bore down and trampled to death the weaker ones. By half-past eleven the living were outrageous and quite ungovernable. At six in the morning the order arrived for their release. At that time only 23 were left alive!"

THESE two tragedies gave rise to the belief that human beings give off a poison which contaminates air. In all scientific grandeur the name of "anthropoxin" was given to this mysterious toxin. Now it is definitely known that air does not become poisoned by being rebreathed. It does have seriously bad effects, but not from being poisoned. There is no "airborne infection," and there is no "crowd poison," to consider in obtaining the right kind of air to promote health and diminish fatigue.

The mythical anthropoxin gave way to a very real carbon dioxide in 1863 when the German scientist Pettenkofer announced that he had devised a method of measuring the carbon dioxide in air exhaled from the lungs. A century before this demonstration the French scientist Lavoisier had discovered the presence of atmospheric carbon dioxide, and with Pettenkoffer's actual measurement of carbon dioxide in the air exhaled from the lungs and finding 100 times as large a percentage in the lung air as in outdoor air, it began to appear as if carbon dioxide were the culprit. But carbon dioxide is not the culprit.

It is true that outdoor air contains less than one tenth of one percent of carbon dioxide, while after the same air is exhaled from the lungs it may contain as much as five percent of the gas. However, it looked suspiciously as though crowd poison was carbon dioxide, and at the turn of the century a wave of legislation started which required public and work places to be mechanically ventilated with exhaust ducts near the floor. Carbon dioxide being heavier than air mixture, it was evident that it would be near the floor and that exhaust ducts pumping out the air from near the floor would quickly remove any excess carbon dioxide. All this is true, but is very unsound ventilating practice for two vital reasons.



TEMPERATURE AND ACCIDENTS

The curve shows that the optimum temperature is 67 degrees; above this and below accidents increase

FOR one thing, never in the course of ordinary events is carbon dioxide a menace, not even in the Black Hole of Calcutta or in the steerage cabin of the *Londonderry;* in fact more than 2 percent of carbon dioxide must be in the bottoms of the lungs to stimulate the respiratory center in the base of the brain which starts and stops the breathing action. The air in even poorly ventilated mines seldom has more than 3 percent of carbon dioxide in it. If carbon dioxide is a poison, then our lungs perpetually are filled with the most poisonous air.

For the second reason; having the exhaust ducts close to the floor results in pumping down to breathing level the air in the room which actually *is* harmful. If any air in a room is harmful to a human being it is the air near the ceiling. A floor-level duct brings this more harmful air directly to the inhabitants of the room. Yet Massachusetts and more than 20 other states demand by statute that their public buildings and work places be ventilated by mechanical systems which exhaust the air at floor level. Thereby they actually add to the perniciousness of the condition.

We are now closer to what has been demonstrated amply as the really undesirable conditions that make air bad for us. The demonstrated truth now is that it is not the air in our lungs but the air next to our skin which is responsible for the effects, whether they be good or bad.

One of the first scientific demonstrations of this fact was dramatic. An airtight room just large enough to accomodate one adult man was built in a German laboratory. Three rubber-covered port-holes were built into the side walls about five feet from floor level. An assistant in the laboratory was placed inside this experimental chamber where he had to breathe the same air over and over again. He gradually became fatigued, drowsy, slightly sick to his stomach, and finally was on the verge of fainting. Then he stuck his head through one of the rubber-covered port holes to breathe the fresh outside air. At the same instant two other assistants who were on the outside of the test chamber stuck their heads through portholes into the chamber, so they were breathing the chamber air into their lungs—one man in the stuffy chamber breathing fresh outside air and two men outside breathing the stuffy air of the experimental chamber. The two breathing the "poisoned" chamber air rich in carbon dioxide did not suffer at all, but the man breathing the fresh air while his body was enveloped in the stuffy, hot damp air of the chamber fainted dead away! His lungs were getting fresh, pure air, but his body was encased in air which it itself had made hot and humid.

IT is the cooling power of the air surrounding our bodies, rather than the purity of air within our lungs, that causes the damage.

In maintaining life and in doing work the body is the scene of ceaseless chemical reactions. Calories of heat are produced and lost. Through it all is the miracle of the body automatically

CARBON DIOXIDE:

In pure, outdoors air	0.040 percent
In air in lungs	5.0 percent
In air in worst ventilated rooms	0.40 percent

SUGGESTED TEMPERATURE STANDARDS:

Offices, drafting rooms, sedentary tasks	67 to 69 degrees F.
Rooms where workers are moderately active and move about	65 to 67 degrees F.
Foundries, blacksmith shops, carpenter shops	55 to 65 degrees F.

NOTE: These temperatures are high unless the air is also in motion.

TEMPERATURES OBSERVED IN WORK PLACES:

Bakeries	90 degrees F.
Laundries	95 degrees F.
Sugar refinery	110-115 degrees F.
Copper reduction	100 degrees F.

SCHOOL-ROOM TEMPERATURES IN 278 ROOMS IN 31 CITIES:

Temperature	*Percent of rooms*
Below 66	6
66-70	40
71-75	37
Over 76	17

keeping its own temperature close to 98.6 degrees. Whenever the temperature of the air surrounding the body rises it throws an excess load on the mechanisms within the body which regulate the loss of bodily heat, so that the normal 98.6 temperature is maintained. Whenever the room temperature goes even slightly above 68 degrees, normally clothed individuals have a taxing burden thrown upon the mechanisms which dissipate their self-formed heat.

When the room temperature becomes 75 degrees the following happens in the struggle of the body to maintain its internal temperature regulation: the heart rate is increased, the walls of the blood vessels relax, the delicate linings of the nasal and throat passages are noticeably and unfavorably affected, the body is more susceptible to whatever poisons actually may be within it and, according to Dr. Leonard E. Hill, it demands an excess expenditure of nervous energy by the autonomic nervous system which keeps up the body tone and co-ordinates the activities of the glands and bowels. Air above 68 degrees cuts down the flood of oxygen-rich arterial blood in the nose and throat, diminishing the resistance of these tissues to the germs of respiratory disease which lodge there. This is largely why colds and pneumonia are more common among those who live in rooms which are heated to more than 68 degrees in winter. It is not the cold, bracing winter air that causes colds and pneumonia deaths; it is the over-heated rooms in which people live.

THAT does not mean that the wisest thing is to go with light underwear and no overcoat into a blizzard, as some health faddists claim. Cold outdoor temperatures are usually less injurious, however, because one can add clothing which will conserve the heat the body is producing, while temperatures above 68 can not be compensated for by clothing.

The brain and muscles suffer fatigue under temperatures above the critical point of 68—except for exceptional air conditions to be noted shortly—since the blood supply is automatically shunted largely to the skin where it will have the most cooling effect. With an increase in room temperature muscular strength decreases, the ability to memorize is diminished, and the rate of performing arithmetical calculations is slowed down, according to the experiments of A. Lehmann and R. H. Pederson. Records reported by H. M. Vernon to the Industrial Fatigue Research Board in England show that there is a 60 percent increase in accidents among men workers in the metal trades when the temperature reaches 80 degrees. The errors made by clerical workers also increase disastrously with rises in the room temperature.

The best air to work in is cool air. The healthiest air to live in is cool air.

Temperature alone does not tell all about air being cool. Probably everyone has had the experience of standing beside a radiator or hot air register and actually shivering with the cold, although the temperature was almost enough to scorch him. The heat causes a rapid evaporation of surface moisture, and this has a cooling effect. A handful of gasoline feels cold because it is evaporating rapidly; a handful of

SCIENTIFIC EXHAUST FAN

The fan (note arrow and circle) is near the ceiling where it draws off bad air

ether feels colder because it evaporates still more rapidly. Dry heat is more cooling than moist heat, but the paradox is that a moist cold feels colder. The amount of moisture in the air affects its cooling power. Relative moisture content, or humidity, as well as temperature, is essential in gaging the cooling power or desirability of room air conditions. A fairly useful index of the effect of air conditions upon efficiency is to multiply temperature by humidity.

AIR in motion is also cooling air. That is where the electric fan has its beneficial effect. It is also to the credit of summer weather that the high temperature is usually offset to a considerable extent by the cooling power of the air which is in motion. The draft from the electric fan is not as injurious as most persons believe; if, in truth, it is injurious at all. It is only the aged, tiny infants, and invalids that need to be worried in the least about drafts. It is not the engineer and fireman on the railway passenger train who catch cold from their draughty cab on the locomotive, it is the passengers in the draft-free and overheated coach that acquire colds for reasons we have already seen.

The more people shut themselves up in overheated houses to "avoid colds" the more likely they are to acquire the very thing they think they have shut out.

Temperature, humidity, and motion are the chief factors in refreshing air. It should be cool air rather than warm air; it should be slightly dry rather than damp; it should be moving rather than still air; and it should vary somewhat from time to time.

This last factor of variability was attained excellently by pioneer heating apparatus—perhaps too well attained. Thermostatically controlled heat which maintains a temperature uniform to a half degree may be comforting, but it is lacking in stimulation. It presents the opposite extreme to alternately roasting and freezing in front of a log fire.

The lassitude known as "spring fever" is seriously attributed by many workers in these fields to be due to the lack of variability. A variability up and down the thermometer of five degrees is invigorating to health and stimulating to efficiency. Office workers in artificial climates kept at a uniform precision by thermostatic controls are half-way on the way toward spring fever. A walk outdoors at the noon hour, or throwing the windows wide open at intermittent periods, introduces some of the benefits of variability. A drop in temperature from 75 degrees to 64 degrees reduces the death rate by 10 percent!

"ELEPHANT AIR" is not necessarily bad air, although it is unpleasant and depressing air. Elephant air derives its name from the anecdote about the small boy who was invited to a birthday party a few weeks after having seen his first circus. Upon entering the home to which he had been invited he shouted with glee, "Oh! They're having a circus. I can smell the elephants."

The smell of the air is socially vital but it has no demonstrated health effects. Apparatus has been developed for infusing the air of a room with ozone to offset other odors, but to many the odor of ozone itself is distasteful. The claims that ozone also kills bacteria is not warranted, at least when in the concentrations at which it can be used in breathable dilutions. Chemists have developed perfumes with a multitude of scents to offset odors which are likely to occur under any ventilating system.

In replenishing the air in a room the most effective general plan is to arrange for room air to be exhausted from the top of the room. For the average room, to open one window at both top and bottom will provide a current system whereby outside air enters at the bottom, and the superheated air at the ceiling is exhausted from the top of the window. To reverse the direction of this stream is to bring the most ennervating air on to the inhabitants. Yet this is exactly what most legislation demands.

Hearing Without Ears

Bone-Conduction Equipment to Aid Partially Deaf Persons

By GEORGE BARTON FRENCH

MANY children with defective hearing have been regarded by both parents and teachers as being dull mentally, the real cause being deafness which remains unsuspected until perhaps 30 percent of the hearing capacity has been lost.

No effort seems to have been made to date to provide hard-of-hearing public school pupils with an efficient mechanical hearing-aid at a reasonable price to enable them to receive not only the benefit of education but also the benefit of the companionship of their fellow-pupils. These children are not only embarrassed during their training period but the affliction, uncared for, will increase with advancing years and interfere to a large extent, if not wholly, with their ability in later years to earn a comfortable livelihood.

Deafness, in the case of a pupil in school is one of life's greatest handicaps. The desire to help a blind pupil is uppermost in the heart of every other pupil not similarly afflicted, but no such consideration goes out to the hard-of-hearing pupil from his or her school-mates.

VERY frequently, in the attitude of companions toward a deafened boy or girl, there is an exhibition of impatience, even resulting sometimes in a manifest desire to shun his or her society. In turn, the effect on these unfortunates is to make them impatient, suspicious, and fearful that they are objects of ridicule. The inevitable outcome is a sense of extreme despair. And these same truths apply with increased force to people who have advanced further in life with this same handicap.

Surveys show that there are in excess of 10,000,000 people in the United States with defective hearing, including 3,000,000 school pupils in need of treatment and of an efficient hearing aid to enable them to keep up with their classes.

Provided the acoustic nerve terminals of the inner-ear are intact, people afflicted with middle-ear deafness may now hear perfectly by a method of sound-transmission referred to herein as bone-conduction, this statement applying even to those whose ear-drums have been extirpated. While the principle behind this method is known to every otologist (ear-specialist) who uses a tuning-fork to test audition, its application as a practical aid to hearing is new.

To explain the principle of bone-conduction, a brief reference to the human auditory apparatus is necessary. The inner-ear—the business end of hearing—begins its process with a membrane called the oval window, on the inner side of which lies the labyrinth, a bony structure enclosing a colloidal fluid. The normal and sole purpose of the outer-ear and middle-ear is to cause this labyrinthine fluid to vibrate with the same frequency which existed in the original sound-waves impinging on the ear-drum of the outer-ear.

With a properly constructed bone-conduction receiver, it is now possible to vibrate this labyrinthine fluid without the use of any of the functions of the outer or middle-ear—practically a case of hearing without ears! The instruments employed are an electrical transmitter which replaces the outer-ear as a collector of air sound-waves, a bone-conduction receiver of special form which duplicates the functions of the middle-ear, an induction coil, and a dry battery, all of small size and weight.

The bone-conduction receiver may be placed in contact with any part of the head, preferably on the temple or mastoid bone. Its cover being thin and elastic, the vibrations of its diaphragm are transmitted with a minimum of loss through the skull to the bony structure of the labyrinth which, in turn, transmits the vibrations to the enclosed fluid.

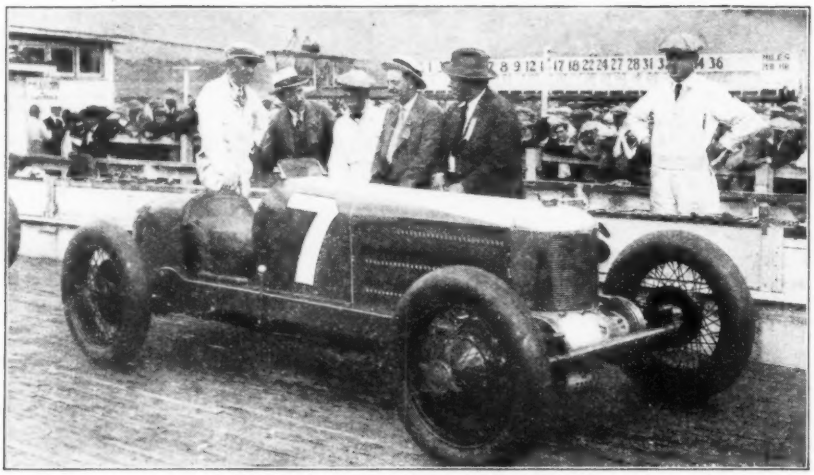
In hearing by bone-conduction, there is no possibility of damage to the auditory apparatus by reason of the sonority of sound-waves, such as always is present when the ear is closed by the pressure of a telephone receiver which leaves no path of escape to the outside air for the sound-waves reflected back from the ear-drum. Such a path is provided by nature in normal hearing. Deafened people should never allow the ear to be completely closed by a telephone receiver, especially if it is equipped with a tip or nipple which enters into and closes the ear-channel.

The most important application of the bone-conduction method of aiding audition is in the teaching of articulate speech and intonation to so-called deaf-mutes. These unfortunates, although in full possession of a normal vocal apparatus, are unable to speak words correctly for the simple reason that they do not hear the sound of their own voices and therefore are unable to make a comparison between the sounds of their own voices and those of their teachers' voices speaking the same words or sentences.

VOICE COMPARISON: TEACHER AND PUPIL

The author, at left, shows manner in which the bone-conduction equipment is used to teach "voice" to a deaf person

DEAF-MUTE children, however, except in rare cases where the acoustic nerve itself is impaired somewhere in its central course, have some degree of residual hearing. The problem has been how to reach it. Today this special bone-conduction receiver, transmitting sonorous wave vibrations through the skull, is able to vibrate the labyrinthine fluid to the extent of forcing the hitherto dormant acoustic nerve terminals of deaf-mutes to receive and to transmit the sensation of sound to the perceptive center of the brain. Recently the writer, using a special bone-conduction receiver, was able in less than a half-hour to teach a boy, who never before had heard the sound of human voice, how to pronounce correctly the entire alphabet, also several short sentences, including intonation of the latter. A new world was opened to him and his delight over being able, through his own efforts, to speak correctly by a comparison of sounds would, in itself, be a sufficient reward for the efforts of any teacher.



MILLER FRONT-DRIVE RACING CAR

Taken at the Altoona track, this photograph shows the Miller car and its designer, Harry Miller, second from the right; in the center is Dave Lewis, at left Harry Hartz, famous drivers

Developments Born of the Speedway

Perfection of Racing Cars and the Terrific Tests They Undergo Teach Many Lessons to the Manufacturer

By WILLIAM F. STURM *

WHEN the Indianapolis Motor Speedway Corporation put out its edict directly after the 1929 500-mile race, that the rules for the 1930 event would be changed radically, there arose a great deal of discussion, pro and con. This discussion took place, not only among the racing drivers, but among the personnel of the automobile factories and extended in ever-widening circles into public channels, for the Indianapolis race is one of the outstanding sporting events of the world.

The new rules are, briefly: That the piston displacement of the engines for the 1930 race shall be limited to a maximum of 366 cubic inches; that valves of the poppet type shall be limited to two per cylinder; that the centrifugal type of supercharger which has been used at Indianapolis and elsewhere on the racing circuit for six years (since it was first introduced at Indianapolis by the Duesenberg brothers) shall be dispensed with altogether; that not more than two carbureters shall be used on the engine; that the bodies of the racing cars shall be not less than 31 inches in width at the cockpit and shall be two-seaters; that the car shall weigh not less than 1750 pounds, with a minimum weight of 7½ pounds for each cubic inch of piston displacement.

These new rules mean that the present type of racing car will have to be sent to the scrap heap. In order to get the proper picture, it is necessary to compare the 1930 car specifications with those that have been in vogue at Indianapolis and elsewhere in organized racing, which is controlled by the Contest Board of the American Automobile Association.

Since and including the 1926 Indianapolis race, the piston displacement limit has been 91½ cubic inches; any type supercharger was permissible; there was no mention as to the number of carbureters; there was no specification as to the width of bodies; and there was no specification that compelled the driver to have other than a single-seater car, which all the racing pilots have had for years. The weight limit was fixed at a minimum of 1450 pounds, although there were few cars that weighed that little, even without gasoline, oil, water, and the driver, as the rules called for.

THE great question: "Why are all these changes necessary?" was hurled by the drivers into the supercharged discussional air that surrounded the Indianapolis motor speedway and the pilots. And in the answer to the question lies the primary reason for the change—a reason that has no bearing on the likes and dislikes of the drivers, nor on the attitude which the race-going public will take on the change. That these two sides of the question — which at first thought would be considered paramount— were not even considered by the men who drafted the rules, gets right at the root of the matter, as the officials of the Indianapolis Motor Speedway Corporation view racing.

According to Edward V. Rickenbacker, former speedway racing driver, war-time ace, and now the president of the Speedway Corporation and an automobile and airplane executive, "the 500-mile race has not been considered as a sporting event, per se, but as an effort on the part of the Speedway Corporation to aid the automobile industry to solve the problems that progressively confront it. It is for that reason that we are making the radical changes in the rules for the coming race. The rules, however, were not drafted by the speedway officials; they were written by members of the Contest Board of the A.A.A. and a group of other men selected from the automobile industry—men who would look at the problem in the light of the greatest good to the industry that made the speedway possible."

The Speedway Corporation has always put up rich purses for the drivers, first place being worth in prize and accessory money, from 30,000 to 40,000 dollars. It has always been a good investment for the driver to spare no expense to design and construct his car so that it would win the 500-mile race.

The motorist who switches on the ignition in his car at the curb, never gives a thought to it. Yet the well-nigh perfect ignition on the car of today is due in part to the demand of the racing driver that he have a type of ignition that would stand up under the

* See "Among Our Contributors," page 5.

grueling test of the 500-mile race. It is no secret at all that more than one Indianapolis race has been lost because of ignition trouble. And it is no secret, either, that one of the most successful types of ignition used in the automotive industry today was freed of many of its "bugs" through the extreme demands of racing.

The average car owner feels aggrieved if he can not take his car out on the paved highway and run it at high speed for hours. And he can do it, because much was learned from speedway racing concerning lubrication. A great part in the automobile engine of today is played by proper lubrication. The speedway races did much to develop the pressure-feed oiling systems that are found on the cars of today that go blithely on their way, day in and day out. The automobile industry profited through the racing driver's necessity, for the pilot had to have a system that would make lubrication positive.

Crystallization of metal used to play a certain amount of havoc with the automobile driver on the road. But if the man on the road had his troubles, what about the driver in the 500-mile race, hurtling along at 100 miles an hour over the rough two-and-a-half-mile course, with four corners to be negotiated in each lap of the track and with the rough brick course setting up more vibration in 500 miles than an ordinary road would in 5000 miles?

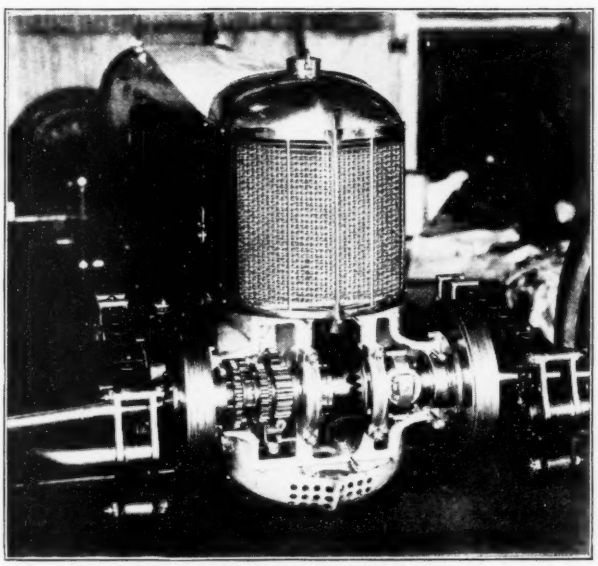
STEERING knuckles, steering arms, and front axles are three vital parts of an automobile, for if they get "fatigued" at the wrong spot in the journey the motorist may wind up in the hospital or the cemetery. For years the Indianapolis track was strewn with the wreckage of cars whose steering apparatus had failed. Today it is unusual for a wreck to be caused by such a fault. Why? Racing drivers have to have fatigue-proof metal, and what they have to have they eventually evolve or have evolved for them. The lessons learned in racing age for any one who cares to apply them.

Time was when a man thought he was "in clover" if he got 3000 miles of wear from his tires. Today tire factories promise ten times that distance and think little of it. The Indianapolis motor speedway has been one of the best testing grounds the factories have had. Tires that were developed for the 500-mile race have been of great aid in making a tire for commercial use that will withstand the high speed and the rough usage it receives at the hands of the driver of today's passenger car.

The difference between poor and good carburetion on the race course is often the difference between failure and success. Acceleration, an important function of the carbureter, is highly important at Indianapolis, with its four corners where the speed falls off and where it must be picked up again rapidly once the corners are negotiated.

IF one is inclined to doubt that carburetion and acceleration play an important part in the selling and using of cars on the street he need only "ask the man who owns one." No one wishes to run the risk of getting run over while driving across a street intersection by some up-to-date car with the proper acceleration; nor does he wish to be "left at the post" when the "GO" sign flashes.

The high-compression motor used by many factories today is a result of the need of the racing driver for an engine that would deliver the maximum of speed and not complain about the compelling power by vigorous knocking.



FRONT-DRIVE MECHANISM

Front end of the racing car in which Lewis finished second, 58 seconds behind the winner, at the Indianapolis Speedway in 1925

The "straight-eight" engine got its real test on the Indianapolis motor speedway, and its introducers in America, the Duesenberg brothers, actually combined their racing and passenger car engineering so successfully that their racing car still holds the 500-mile record at Indianapolis, while their passenger cars are recognized as among the fastest on the road. Other eights came along after the Duesenberg and one manufacturer even went to the extent of advertising that his eight was "born of the race track."

While four-wheel brakes are not so essential on the speedways as they are in road racing, Duesenberg, first American engineer to use four-wheel and hydraulic brakes, had his Indianapolis speedway cars equipped with them and gained much knowledge from their use there.

Racing cars, since the speed has risen higher and higher, have been designed with an eye to keeping them right side up. One of the essentials is a low center of gravity. A low center of gravity on the passenger car of today keeps it right side up on the road, where car speed now is faster than racing speed was only 20 years ago.

The Indianapolis Speedway did much for the present-day * front-drive automobile, which was first introduced in a race there in 1925 by Harry Miller, Los Angeles engineer. The first front-drive ran as faultlessly as could be, but as others were built and used they developed several bad "bugs" which it took years to eliminate. But the problems that confronted the front-drive were gradually solved under conditions much more rigorous than ever would be confronted on the road, and it was a racing engineer who developed the first passenger car of the breed. After two years of trying out, the front-drive has developed so far along the primrose path of automobile perfection that one of the most beautiful production cars of the present era is a front-drive. Another front-drive is now far on the road to success and production is expected to be started on it in a few months.

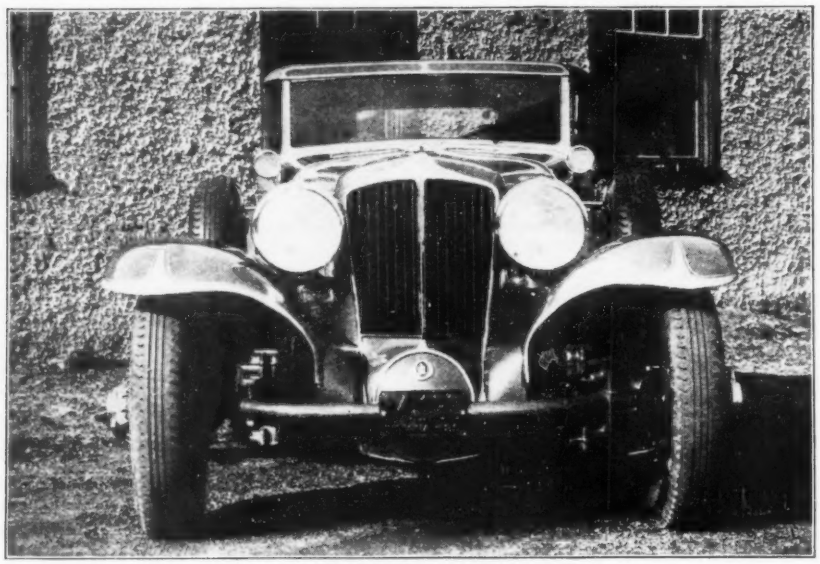
FOR all the years there has been an Indianapolis 500-mile race, there have been automobile factory engineers in attendance on it—car designers who come for a week before and stay for a week after the race. These engineers do not come out of mere idle curiosity; they come because they realize that racing is, in truth, the crucible of the automobile industry.

The Indianapolis Motor Speedway Corporation does not take all the credit for the development of the modern automobile. But in all the years that there has been an annual 500-mile race on the great brick course, the rules have pointed toward the one end—the greatest good to the development and experimental work of the

* Walter Christie built front-drive cars a score of years ago, but they were not made in any quantity, and soon faded from the automobile picture.

automotive industry as a whole.

In 1911, when the first 500-mile race was run on the speedway, nine tenths of the production cars were of four-cylinder design, with huge engines—power plants whose pistons had a diameter of from five to seven inches and whose stroke was represented by the same figures. The power was derived from the great capacity of the cylinders and the combustion chamber, and this all made for a slow-moving, ponderous motor, which was considered "revving" at terrific speed if it reached 1800 revolutions a minute. The car was not "flexible," and this made for a lot of gear changing, as the least resistance to the car's forward movement meant a laboring engine, which called for an immediate shift into a lower gear. The oiling was of the splash type, that is, the cylinder walls and connecting rod bearings were lubricated by a spoon on the lower connecting rod bearing dipping into a shallow oil trough and literally splashing the oil to the parts needing lubrication.



NOW IN COMMERCIAL PRODUCTION

The front-drive principle, as applied to stock passenger automobiles, gives a rugged, clean-cut appearance. The illustration here is of the Cord car, described in detail on page 28

THE automobile as a whole and its individual parts were rather massive, for the industry had not yet learned that steering knuckles, axles, and other vital parts could be small and light as to weight, yet strong. The car was just a good big brute, with all the crudeness that one associates with a good big brute. And with it all, it sat well up in the air, and this height tended to make the center of gravity high and tended to make the car difficult to handle at speed.

Consider the car of today: The pistons are little more than half the size of the 1911 product. The combustion chamber is smaller and designed to handle higher compression than prevailed in the ancient cars. An engine that will respond on demand to a speed of 3600 revolutions per minute is not unusual. The oiling systems in a large degree are of the pressure type, designed to lubricate perfectly the bearings and the cylinder walls as the car floats along at from 50 to 90 miles an hour, in a way that never could have been done with the splash system, which considered itself overworked if it had to provide for a speed of 60 miles an hour for short distances, and whose operation depended a great deal on the car being fairly level for best results.

A great deal of attention has been paid to a low center of gravity in the present-day car. One has only to note the cars that go flashing by. Some of them seem actually to be rubbing the ground.

The car of the present moment is eight-cylindered, with experimental work going on in one or two factories for double that number. Multiple cylinders make for extreme flexibility. Gear changing is reduced to a minimum and one of the bugbears of women drivers is thus eliminated. The eight-cylindered car came to the Indianapolis track because the racing drivers recognized in its multiple cylinders something they needed in their business. It came into production because the manufacturers recognized in it something to fill a vital need.

After the 1911 and 1912 Indianapolis races had been run with cars of a piston displacement limit of 600 cubic inches, the speedway owners, with that rare vision that has made their race the wonder of the world, saw that the gravel and dirt roads would in time be giving way to those of the hard surface type. They foresaw the speed curve of the automobile rising higher and higher. They must have realized that in the nature of things the automobile would have to change to accommodate itself to the change in conditions under which it was to be used.

The then owners of the speedway, Carl G. Fisher, James A. Allison, Frank H. Wheeler, and A. C. Newby, had all prospered through the automobile industry and were due to prosper much in the future. They felt they owed the industry a debt of gratitude and the payment, they decided, was in the use of the speedway as a laboratory for the industry. In furtherance of this idea, they decided that the rules for all their races should be drafted so that they would anticipate by two or three years as nearly as possible the trend in the industry.

Accordingly, in 1913 and 1914 the piston displacement limit was set at 450 cubic inches, to anticipate the downward trend in the size of the automobile engine. At this time the race entries were all factory cars and in effect merely stripped-down stock cars.

IN 1915, 1916, and 1919 (there were no races in 1917 and 1918, the war years) the piston displacement limit was reduced to 300 cubic inches. Factories still participated in the race, although not so heavily as in the early years. Whereas even stock parts were used on the early cars, now began a gradual change from stock parts to specialized parts where the racing strain was greatest.

The year 1920 ushered in the rule that the cars must be of 183 cubic inches displacement. This year saw the real beginning of the highly specialized, specially-built racing cars.

In 1923 the displacement was re-

HIGH AND AWKWARD

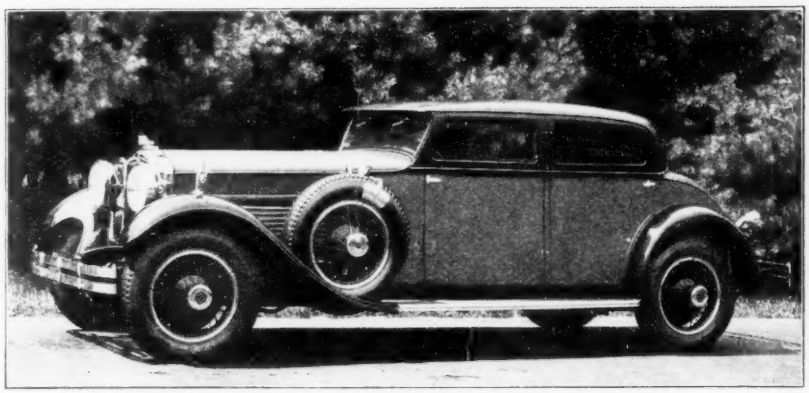
One of the first: Elwood Haynes, the automobile inventor, in his 1893 buggy-like car, a sputterer which stood high on its wheels

duced to 122 cubic inches and in 1926 this was changed still further downward to 91½ cubic inches, a quart and a pint, just half the size of the Ford motor of that day. That year, too, saw the inauguration of the one-man racing car.

There was a definite rise in the motor speed with the gradual decrease in the piston displacement. With 600 cubic inch cars the engine speed was approximately 1800 revolutions per minute, in rare cases 2000; the 450 cubic inch cars showed a rise to a top speed of 2300 revolutions; 300 cubic inches, 2800 to 3000 for four cylinder cars and 3500 for eights; 183 cubic inches, to as high as 4000; 122 cubic inches to a top of 5400; 91½ cubic inches to as high as 8400, with an average top of 7000.

IT is true that the present-day manufacturers are not using such high engine speeds, but they are able to get much valuable information from such speeds.

When the Indianapolis Motor Speedway Corporation reduced its engine maximum size to 91½ cubic inches it felt that it had reduced it to the minimum, so far as benefit to the industry was concerned. It had, through the ingenuity of the racing drivers and the engineers who did the work for them, shown the automotive industry (1) that engines with a top motor speed of 7000 revolutions per minute were possible; (2) that lubrication could be had at those speeds; (3) that great horsepower could be obtained from small engines, as these small supercharged power plants developed in excess of 200 horsepower; (4) that reciprocating parts could be so well designed and balanced that they would perform satisfactorily at such high speeds; (5) that parts of the automobile that had to withstand great stresses could be built strongly, even though of light construction.



LOW-HUNG, RACY, WELL BALANCED

In this modern car many things learned on the race track have been incorporated. The Stutz here shown, and its companion, the Blackhawk, were almost literally born of the track

So long as a small high-speed engine would benefit the industry, the speedway clung to it. When the centrifugal type of supercharger was introduced and it was thought it would eventually be of use to the automobile manufacturer, the speedway aided in its development. Today it is known that the centrifugal type is not the supercharger to be put into the car that goes to the person in the street, because of its high speed—upward of 40,000 revolutions per minute on racing cars—and its delicate adjustment.

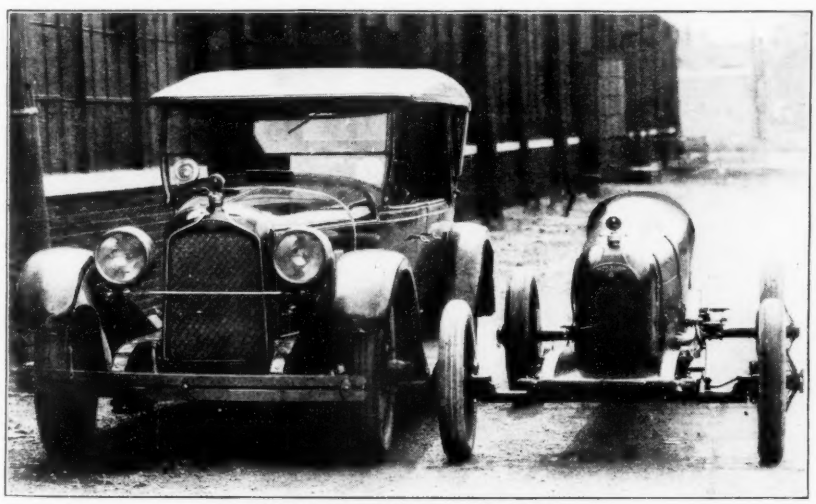
With hard paved, wide highways, and the demand for high speed in production cars, along with comfort, the demand has swung back along the trail. There will always be small cars and small power plants, it is true, just as there probably will always be four-cylinder cars in this class. But the medium-priced and the high-priced demand in America is for a car that approximates in size those of earlier days. The engines have not traveled so far along the backward road as have the cars themselves. High car speed and power may be had with a medium-sized motor, with high engine speed. These cars, with their multiple cylinders and other improvements, have all the flexibility to be attained with any engine, regardless of size.

With the demand, then, so well pronounced for a medium-size engine, the Indianapolis Motor Speedway Corporation, true to its tradition, feels that it must fall in line and aid in its development. It bans the small car, bans the supercharger, and asks the driver to get his carburetion from two carbureters instead of the eight that were used before the advent of the supercharger. Two carbureters are specified because that is the trend in the industry where eight-cylinder cars are concerned. The two-man body is added, because it more nearly approximates stock car design and the mechanician alongside the driver is expected to make racing safer, although this particular point may be open to question.

Now that the slow-speed, blower-type of supercharger, which runs at engine speed, instead of five times faster, is becoming a factor in cars that demand excess speed and excess power for heavy going, there is little doubt that the speedway may, in time, permit its use to aid the industry.

IT may all be explained in one sentence: The Indianapolis Motor Speedway Corporation feels that its track can be of more use in developing the features that are part of the cars of today, than in continuing to race with the highly-specialized small-engined cars of the past that have given all they have to offer to the industry.

¶ *An ocean covered the land; millions of minute sea animals died, sank to the bottom, and the embedded mass became marble when the water receded. Marble, the memorial stone, will be discussed in an article soon.*



BROTHERS UNDER THE HOOD

A Duesenberg touring car of 1926 and, beside it, the Duesenberg racing car of that year. Duesenberg, a veteran racer, was the first American engineer to use four wheel brakes

Photo by Max Bégouen

ENTRANCE TO THE CAVE OF TUC D'AUDOUBERT IN SOUTHERN FRANCE

Access may be had only by means of a row boat in which one ascends the stream a short distance, then clambers up through a small opening. The cave was discovered on his own estates by Count Bégouen in 1912. It contains many treasured evidences of prehistoric man

When Reindeer Roamed the Pyrenees—II

How the Anthropologist Explores the Buried Evidence of the Ancient Past and Reconstructs an Outline of Prehistory

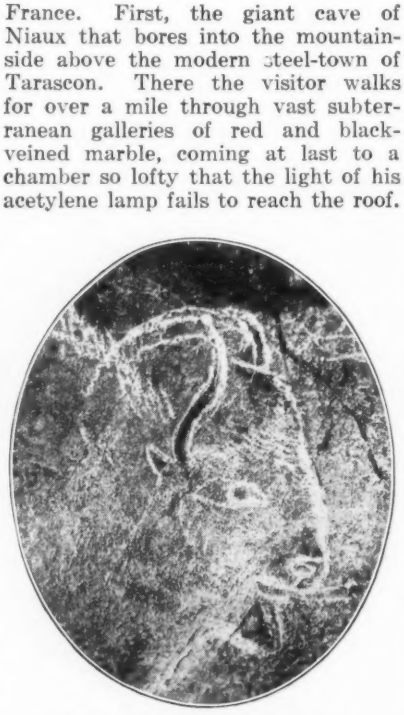
By IDA TREAT, Ph.D. (SORBONNE)
Co-author of "Primitive Hearths in the Pyrenees"

(Concluded from December 1929)

WHILE the sites of buried civilizations in Dordogne have for the most part been accurately mapped, there exists as yet no complete guide to the prehistoric underworld of the Little Pyrenees. Many "painted" caves have been discovered and explored and many Stone Age shelters excavated. But no one knows the exact limits of this portion of the cave man's country, for the whole district is honeycombed with caves.

THERE are caves with galleries vast as a cathedral nave and caves like rabbit-holes; caves that open gaping mouths in the hillside and caves completely choked at the entrance with earth and fallen rock; caves that consist of a single short tunnel, and labyrinth caves with dozens of branching passages. Some have long been known and explored; others no man has penetrated since the cave men left them; and still others for countless centuries have served as shelter only for wild animals—dens of the ancient cave bear and cave lion, and today the haunt of foxes.

Three of these caverns count among the great prehistoric art sanctuaries of France. First, the giant cave of Niaux that bores into the mountainside above the modern steel-town of Tarascon. There the visitor walks for over a mile through vast subterranean galleries of red and black-veined marble, coming at last to a chamber so lofty that the light of his acetylene lamp fails to reach the roof.



ENGRAVED BISON'S HEAD
From the cavern of Tuc d'Audoubert. Photographed by Max Bégouen

At the top of a steep incline of sand he stands before one of the marvels of prehistoric art, a row of animal figures painted in black on the rock wall, startlingly life-like, a bison, horses, and a wild goat. In appearance, the paintings seem as fresh as if they had been traced there yesterday, but over them all lies a thin transparent "varnish"—a stalagmitic coating deposited there by the slow oozing of lime-charged water through the rock, a stony guarantee of their authenticity.

A FEW miles distant lie the twin caves of Tuc d'Audoubert and the Trois Frères, less spacious than the great cavern of Niaux, although the longer of the two is nearly a mile in length. Both are difficult of access. A subterranean river flows from the opening of the Tuc. To enter the Trois Frères, one must climb down a pit for over 100 feet at the end of a rope. Each cave consists of fairy-like chambers hung with snowy stalactites, low passages with barely space enough to crawl, and upper galleries which can be reached only by scaling vertical walls of rock.

The Trois Frères owes its renown to a series of 300 animal engravings and a strange figure that looks down

from a high niche in one of the rock chambers—half man, half beast, perhaps the sorcerer or shaman of the cave man's tribe, or perhaps a strange god of this buried heathen world. The cave of Tuc d'Audoubert contains, together with many engraved drawings of animals, a unique example of prehistoric sculpture: two bison modeled in clay that today is as plastic as when the cave-artist laid aside his tools 300 centuries ago!

In these two caves as in no other, you realize that these underground art galleries were in no sense prehistoric habitations, but sanctuaries, hidden temples for the celebration of mysterious ceremonies and strange sacred rites. In one low chamber close by the modeled bison, you see hundreds of human footprints beneath a thin stalagmitic layer, footprints that go 'round and 'round as if in a primitive dance; while on the clay floor lie strange clay objects, modeled symbols of an ancient phallic cult.

Photo by Max Bégouen

ONE OF THE MODELED BISON OF TUC D' AUDOUBERT

It and a male bison figure, which does not show, no doubt had something to do with magic rites supposed to control the reproduction of the animals used for the ancient hunters' food

YOU can imagine the scene: the weird glare of smoking torches, the crouched, dancing figures—faces barred with paint, and bulky garments of skins; and perhaps standing by the modeled figures of the bison the sorcerer himself, masked and terrible, the artist and master of ceremonies.

Here too you can understand why the cave man did not dare venture often into the dark inner recesses of the cave. Driven from the entrance by the presence of man and his campfires, the cave bear no doubt continued to haunt the labyrinth of inner galleries. Today you see his traces everywhere—his clawmarks on rock and floor, the hollows in the soft clay where he slept, and the imprint of the furry haunches and paws of the great beast, a formidable adversary at close range for men armed only with weapons of flint and bone.

Photo by Max Bégouen

LITTLE BISON ENGRAVING

Also from Tuc. The prehistoric artist had a knowledge of form and posture that would do credit to modern art

You may even conclude that the modern child's fear of the dark might well be a legacy from the cave ancestor to whom daylight or the glow of the camp-fire spelled safety, while darkness meant hostile, hungry beasts. The bold child or man who wandered away from the protecting flame risked a sudden and untimely end.

Aside from the three main sanctuaries there are other art caverns in the Plantaurel: Le Portel with its red horses and black bison; Montespan with its magic signs and crudely modeled clay figures; Gargas and its arabesque designs, its walls spattered with dozens of human handprints on a white or colored ground; and still other caves that contain isolated drawings, splotches of color or an occasional red arrow painted on the rock wall pointing to an upper passage or an inaccessible "chimney."

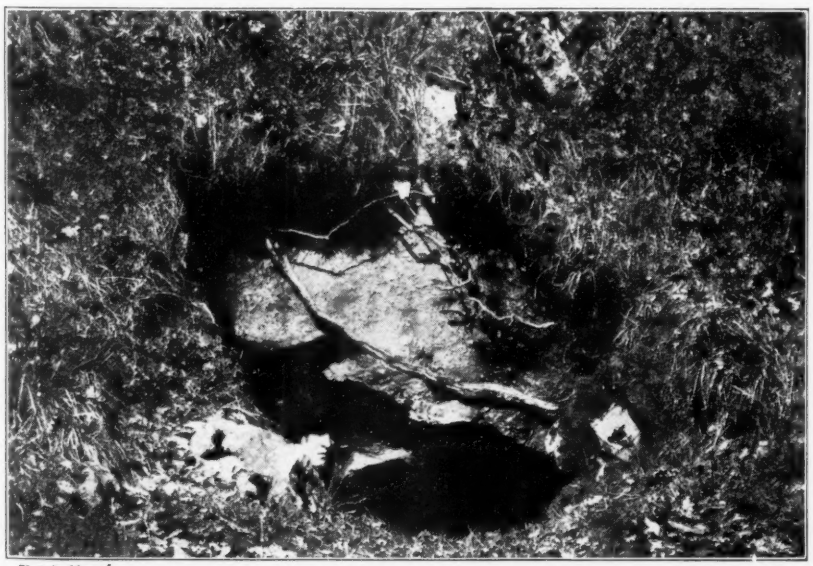


Photo by Max Bégouen

ENTRANCE TO THE CAVE OF TROIS FRERES

This cave, which is closely adjacent to the cave of Tuc d' Audoubert, was discovered in 1914 by Count Bégouen and named "Three Brothers" for his three young archeologist sons

BUT the caves that sheltered the cave man are far more numerous than the painted sanctuaries. Like modern towns that cluster about their churches, so the settlements of the Cro-Magnons seem to have comprised a multitude of rock dwellings in proximity to a cave temple for the celebration of his magic cult. Not that dwellings nor sanctuary were necessarily permanent, since the nomad hunters must have shifted their settlements as the herds of game wandered from one part of the region to another. But wherever they camped, the temple of their primitive religion seems to have formed a part of the cave man's life, fully as essential as the cavern that sheltered the tribe and its camp-fires.

For at least 50 years scientists have turned their attention to the pre-

historic caves and shelters of the Plantaurel. They have discovered and explored painted caves and excavated the cave man's refuse heaps, removing the successive layers of ash, bone, and flint deposited there by Neandertal and Cro-Magnon man. But anyone who goes climbing today among the limestone ridges of the Plantaurel, pushing his way through the tangle of scrub oak and briar that masks the rocky slope, comes speedily to the conclusion that much of the prehistoric underworld still remains to be discovered.

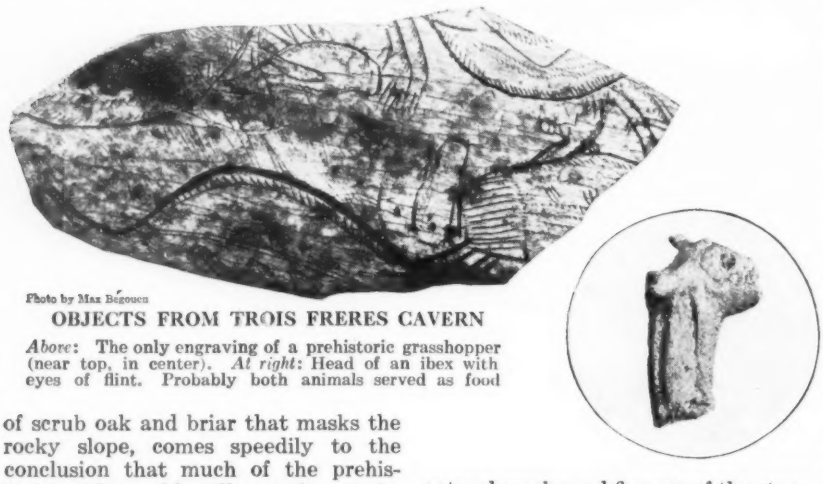


Photo by Max Bégouen

OBJECTS FROM TROIS FRERES CAVERN

Above: The only engraving of a prehistoric grasshopper (near top, in center). *At right*: Head of an ibex with eyes of flint. Probably both animals served as food

Since 1924, I have explored and dug in a part of the Plantaurel that lies about five miles distant from the great art caverns of Tuc d'Audoubert and the Trois Frères. In a district not more than 10 miles square, I have visited dozens of unexplored caves, their entrances for the most part hidden by underbrush or blocked with fallen rock.

ONLY a fraction of these had ever afforded shelter to Stone Age man who, I discovered, showed considerable similarity with the modern apartment hunter when he set about choosing his lodgings. He preferred commodious quarters, although not so vast as to be drafty, with wide openings to admit light and air, and wherever possible a sunny southern exposure. He liked caves that open on a broad terrace where in pleasant weather he could work and eat in the open; and he wished his water-supply close at hand. Such caves, I found, almost invariably contain traces of the cave man's presence and were occupied practically without interruption by the successive Stone Age populations. Caverns less favorably located sheltered intermittent guests; and some dark and drafty holes had served merely as an occasional night's lodging for groups of hunters. Of all the caves I visited, seven yielded prehistoric hearths. Three of these I have already excavated; the fourth cave is being dug.

Each time you enter an unexplored cavern, you look for two evidences of the cave man's presence—mural art and hearths. You advance slowly through the dark passages, holding your miner's lamp at arm's length and scrutinizing walls and roof for traces of color or the lines of an engraving. It takes no particular skill to detect a prehistoric painting on the rock wall, but you need a practiced eye to distinguish an engraved line from the natural cracks and fissures of the stone. Even when you succeed in making out a detail of the drawing it requires considerable focusing of the imperfect light before the whole design is visible in a complete and distinct outline. Often, too, the cave wall may be covered by a tangle of engraved figures, some standing on end, others lying on their backs—a confused interweaving of lines like a complicated puzzle.

No niche is too small to be examined. I remember one little horse no larger than the palm of a hand, exquisitely cut like an etched gem in a dark hollow of rock only a few inches above the cave floor. In an oven-like chamber so low that the artist must have worked lying on his back, the outline of a deer had been carefully engraved in the smooth limestone of the vault. As a general thing, spots which prove almost inaccessible to the modern explorer seem to have offered little difficulty to the prehistoric artist. It requires breakneck gymnastics to approach within reaching distance of the "sorcerer" in the cave of the Trois Frères; its creator must have clung like a fly to the vertical wall while he cut and painted the masked figure.

WHILE cave exploring in the Plantaurel does require a certain amount of acrobatics on the part of the visitor, it offers little actual risk. No more, in fact, than confronts the small boy who goes clambering among the rocks at the sea shore. The low passages through which you must crawl are generally smooth semicircular tunnels; in the larger galleries it is comparatively easy to avoid dangerous proximity to holes or rocks which look as if they might crash down at any moment.

The only really unpleasant caves are those that earthquakes have fissured and shaken into a chaotic disorder of rock and clay, but in these you risk little chance of discovering the cave man's trail. Disagreeable, too, are the "carrion" caves, pits into which the Pyrenees peasants have flung dead farm animals for many generations. Such caves you generally avoid, however keen your scientific curiosity, although it may happen—as it did once to myself—that while exploring a passage you may come upon such a pit. On that particular occasion, even before we realized the meaning of a heap of animal bones at the end of a long gallery, the flame of our lamps dwindled to a red spark from the lack of oxygen and we beat a hasty and undignified retreat.

Underground streams represent an

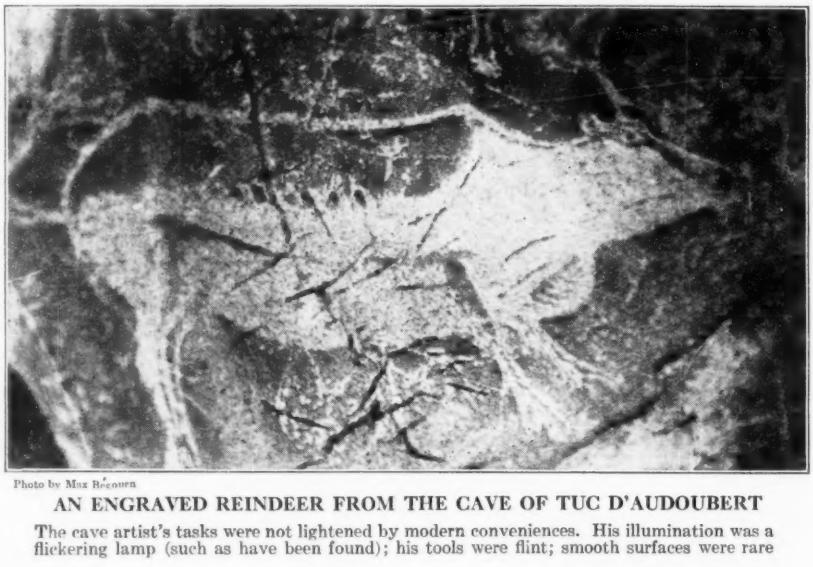


Photo by Max Bégouen

AN ENGRAVED REINDEER FROM THE CAVE OF TUC D'AUDOUBERT

The cave artist's tasks were not lightened by modern conveniences. His illumination was a flickering lamp (such as have been found); his tools were flint; smooth surfaces were rare

inconvenience rather than a danger. Their volume in the Plantaurel district is rarely important, but the water is icy cold and to cross them means that you continue the exploration in clammy, sodden garments. If the water proves too deep to ford on foot, it is not over prudent to trust entirely to your ability as a swimmer. A couple of square gasoline cans make safe and convenient floats.

ASIDE from the prehistoric mural art which may, or even more frequently may not, be present on the cave walls, the explorer keeps an eye constantly on the cavern floor for traces of the cave man's hearths. For while Stone Age man did not inhabit the dark inner galleries, he occasionally built a fire there, perhaps to prepare a sacrificial meal. Frequently such hearths lie on the present surface, partially welded to the floor by a layer of stalagmitic deposit. Your light falls on a blackened stone or two, a few fragments of charred bone, a forgotten flint tool. It may be an engraving tool, the very *burin* that the cave artist used to cut the outline of an animal on the wall above!

Often, too, the primitive hearth stones may have been covered by a layer of clay brought there by water long after the days of Stone Age man. If so, the explorer's only resource is to dig. That is to say, you select a likely spot and make a "sounding." If lucky, you may happen on a hearth; more frequently however you encounter merely a layer of sand, stalagmitic material, or of flaked clay—the original "bear clay" of the cave bottom—that contains only the bones of the cave bear and his animal contemporaries, the cavern's earliest inhabitants. After a few fruitless attempts you generally give up the search for scattered hearths; their presence is always problematical and to find them would necessitate digging up the entire floor of the cave, an immense task.

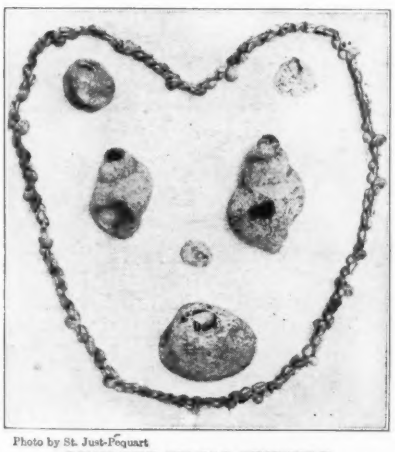


Photo by St. Just-Péquart

OBJECTS FROM THIVIEC

A necklace and ornaments. These objects date very roughly about 10,000 B.C.

Back in the entrance chamber of the cavern there is always a much better chance of finding prehistoric hearths and refuse heaps. A systematic search shows that fires were sometimes built in the center of the chamber, sometimes against the walls; or if the cave had many occupants, hearths may be distributed over the entire floor. You do not find them on the surface. They lie beneath a layer of stone fragments weathered and fallen from the roof, and earth brought in from out-of-doors by water or the paws of animals. Or they may be sealed beneath a stalagmitic layer. In one cave of the Plantaurel—the cave of Gargas—the stalagmitic layer is in places 20 inches thick. The excavator cuts through it with quarrier's tools, lifts off the limestone blocks and underneath, welded together in a compact stony mass, lies the kitchen refuse left there by Cro-Magnon man 30,000 years ago.

In some of the more habitable caves, the digger finds heaped in successive layers the kitchen refuse of a complete series of Stone Age civilizations from Neandertal man to the Azilian fisherfolk. In others he may uncover traces of a single civilization. But in each layer, even though he may find no human bones, the animal remains and the type of flint and bone instruments tell in what civilization he is digging. A single flat harpoon says: "Azilian"; a fragment of reindeer antler means Cro-Magnon men; a triangular flint point and a rhinoceros tooth reveal the presence of the Neandertals. From the material taken from the ground and the carved and painted signs on the cave walls it is possible to reconstruct the history of the cavern through the long period when men of the Old Stone Age lived and hunted on the frozen steppe that today is southern France.

An occasional stroke of luck may bring to light an important discovery, but on the whole it is the painstaking every-day business of excavating that contributes the most valuable documents to the still incomplete record of the cave man's existence. The excavator's goal is not to find "museum pieces," although to dig up a fine bit of sculpture, a beautiful piece of chipped flint, or the bone of a hitherto unknown animal does represent the high-spots of his work. His task is to build up a careful cross-section of the far-away period from fragments which taken individually may appear quite unimportant.

"Stick to a site you know and dig it to the end," might be his motto. Indeed, the most important discoveries made in France within the past few years have come not from "wild-cat" prospectors for prehistoric treasure nor enthusiastic glory-hunters, but from men who for years have excavated—stone by stone and bit by bit of earth and clay—shelters and caves which, judged by their daily, weekly, or even monthly output, scarcely seemed to justify the effort.

Ten years of constant digging enabled Dr. Henri Martin to uncover a series of prehistoric burials and brought about the discovery of a sculptured stone frieze—bison, cattle, horses, and human figures—the most interesting example of the cave man's stone carving yet known. Careful excavations in an insignificant little cave of the Plantaurel led M. de St. Périer to find the little "Venus" of Lespugue, a tiny goddess of fecundity, the most beautiful of Stone Age images. Each year the patient work of Count Bégouen and his sons in the caves of Tuc d'Audoubert and the Trois Frères, and of M. Peyrony in the Dordogne region, bring to light new art objects carved in stone and bone by the primitive Cro-Magnon artist.

FINDS AT THIVIEC

At right: The prehistoric cemetery. Two skeletons and three hearths were found

THE most recent discovery of the bones of prehistoric man was made not in the cave country of the Pyrenees, but on an island off the Brittany coast. On the barren little isle of Thiviec, in a thin layer of soil never yet disturbed by a plow, Monsieur and Madame St. Just-Péquart uncovered almost on the surface a veritable prehistoric cemetery. Among heaps of ashes and kitchen refuse they found primitive "tombs" containing marvellously preserved human skeletons. A peculiar feature of these burials was that each skeleton lay crouched beneath a tent-like structure of deer antlers. An examination of the animal bones and flint tools that accompanied the burials showed that this prehistoric cemetery is older than the curious stone monuments, the menhirs and dolmens of Brittany, that it dates in fact from the last period of the Old Stone Age. The men who lay buried on the island of Thiviec belonged to a race similar if not identical to that of the Azilian cave men of the Pyrenees.

Hunting Pocket Planets

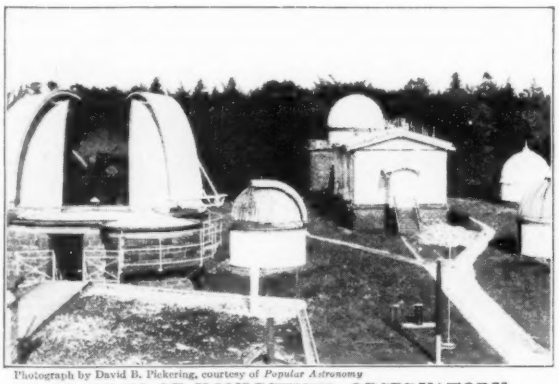
How the Astronomical Specialist Applies Scientific Management to the Systematic Search for New Asteroids or Minor Planets

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

IT is doubtful whether any man living could give from memory the names of all the known planets in our solar system. Many a reader may gasp at this statement and say to himself "Mercury, Venus . . ."; yes, every high school graduate knows or should know the eight large planets. But how about the thousand and more of small ones, the asteroids? The lore of classical, Teutonic, and Norse mythology has been well nigh exhausted in naming them; countries, cities, and universities have been commemorated, and to memorize the names which follow one another on a page or two of the list would be like recalling the names of the Pullman cars that leave a terminal station.

But before the tiniest planet can be named it must be discovered and its orbit worked out. In the old days of visual observation the search was most laborious. After making, through weary hours, a chart of all the faint stars in some region of the sky near the ecliptic where planets are likely to pass, the observer went over the region night after night hunting for stars not on the chart. In time he might find a moving body—a new planet. One enthusiastic amateur was so rewarded after 15 years of unsuccessful labor.



Photograph by David B. Pickering, courtesy of *Popular Astronomy*

SECTION OF KONIGSTUHL OBSERVATORY

Here Professor Max Wolf has discovered his long list of asteroids. The observatory is 1500 feet above Alt Heidelberg

BUT in modern times the discovery of planets has become a matter of "scientific management" and is done almost by machinery, thanks to the aid of photography. The pioneer in this work, Dr. Max Wolf, of Heidelberg, is still actively engaged in it after nearly 40 years of successful searching, and a recent visit to him at the Königstuhl Observatory suggested to the writer this present subject.

The asteroids are so small that they look exactly like stars, even with the greatest telescope. They may be distinguished from the thousands of faint stars which fill the field of the plate only by their motion. Fortunately this motion is fairly rapid, averaging about a quarter of a degree a day or half a minute of arc in an hour. If then an astronomical camera is directed toward the proper region and an exposure of two or three hours is made, following the stars carefully with the aid of a guiding telescope attached to the instrument the stars will appear on the negative as black dots, but the asteroid as a streak or trail which may immediately be picked out on inspection of the plate. All that is necessary is to pick out a likely region, preferably on the ecliptic and nearly opposite the sun, take the photograph and keep on again and again till the wished for trails appear.

A powerful instrument with a wide field of good definition is required and it is very desirable to have two such cameras mounted side by side on the same axis, as Dr. Wolf has. Then the reality of the faint trail may be confirmed "out of the mouths of two witnesses" and there will no longer be trouble from defects on the plate which occasionally look so much like planet trails as to deceive even the experienced observer.

All the known planets which fall within the field of the plates are of course automatically rediscovered, along with any new ones which are bright enough to appear. It is possible theoretically to calculate in advance where the known planets ought to be, but this is so much work that it is easier and cheaper to rediscover everything and then pick out the planets which are already known. This demands less calculation.

How things go at present is illustrated by the report of last year's work at Heidelberg. Sixty pairs of plates were taken by Dr. Reinmuth with a 16-inch double camera, and 139 single plates by Dr. Wolf with a 28-inch reflector. Upon these plates 99 new planets were discovered and 148 known ones re-observed. A comet was also discovered by Dr. Reinmuth.

It is evident that the asteroid seeker has still pretty good hunting. On the average 1¼ new planets were discovered for every pair of plates taken with the double camera. With the reflector, which has a much smaller field of good definition, one discovery was made for every five and a half plates taken, but these plates are of great value in recording the position and brightness of the very faint stars and so have additional scientific usefulness.

So far as the mere exposure time goes a planet was discovered for every two hours work with the camera and every four hours with the reflector. But this statement, while it shows to what an admirable degree of efficiency the asteroid work has been brought by years of experience, gives no idea at all of the amount of work which is involved.

SOMETIMES clouds come up and spoil promising beginnings. Moonlight fogs the plates so that no work can be done near the time of full moon. Clear moonless nights must be utilized to the full, although the flesh threatens rebellion.

There is a tale of a young assistant who, having completed two three-hour exposures on different regions, started in the small hours of the morning upon the third. With a good driving clock the task of watching the guide star and keeping it on the cross wires was not strenuous. The surrounding darkness and the steady monotonous clicking of the clock control did not encourage insomnia, and the observer knew no more till he was awakened by the rays of the morning sun shining faintly into the dome.

When the plates are taken and developed the heavy work is only begun. They must be most carefully examined under the microscope, going over every square millimeter of the image in order that nothing be missed. The new planets are all faint—if they were bright they would have been picked up in past years—and only an experienced observer can be sure that the faint trails are real. But suppose that

a trail has been found, confirmed on the duplicate exposure and marked on the plate. Before the discovery can be of use to anyone else, the planet's exact position must be measured. This demands more work with a micrometer microscope, measuring not only the planet but neighboring stars whose places in the heavens are accurately known, and following up the measures by the necessary calculations.

Then the planet must be found again and observed on at least three nights if a rough orbit is to be calculated. With set fair weather this is not difficult, but only too often unfriendly clouds intervene or the full moon puts a stop to observation and when the next good chance comes the planet can not be found.

IT may have been receding from the earth and have grown fainter, or the rough idea of its motion gained from the original trace may not suffice to locate it after a fortnight. Anyway a considerable fraction of the newly discovered planets get lost again before the three requisite observations have been obtained, despite the best efforts of the observer. Sooner or later these lost planets are likely to be rediscovered and it is a commonplace to hear that a calculation reckoning back with the aid of the orbit finally computed from an adequate set of observations, has found that observations of "lost" planets in earlier years belong to the same body.

Planets get lost in another way, too. The observations of the first season are often insufficient to give anything better than a rough orbit, and if the planet is missed for a year or two thereafter the calculated position will no longer be good enough to tell where to point the camera. Some planets are thus lost for decades and then rediscovered. For example, an asteroid discovered in 1873 and named Aethra was lost in this fasion and only rediscovered in 1922, nearly half a century afterward.

The number of "known" asteroids for which we have good, or at least fairly good, orbits now amounts to more than 1100. Yet two new ones are still discovered for every three old ones that the plates pick up. It is reasonable therefore to conclude that there are at least 700 more which await discovery. Making allowances for improvement in the methods of search it appears probable that the number of small planets in our lists will reach 2000 before the hunting becomes poor enough to discourage further searching.

Even then, the observers will still have plenty to do and the theoretical astronomers much more. The orbits of the asteroids come much nearer to Jupiter than do those of any of the larger planets, and the changes in the orbits produced by Jupiter's attraction are correspondingly great. An accurate calculation of the perturbations

From Russell, Dugan and Stewart's "Astronomy," Courtesy of Ginn and Company

DISCOVERING AN ASTEROID

The technique is described in the text. Arrow points to asteroid's trail (retouched)

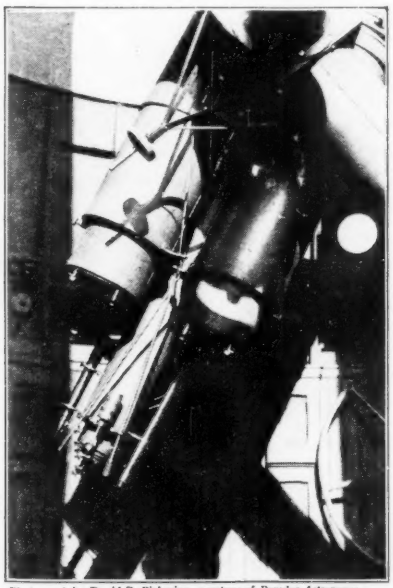
of one of these "little rocks" would in most cases be an enormous job. If it should be desired to predict the position as accurately as it can be observed, each of the 2000 asteroids would demand an amount of mathematical work which would average at least as great as that involved in the famous Lunar Theory. Roughly speaking one may guess that from 30 to 50 years work by a skilled mathematician with assistant computers would be required in a typical case. There is no fear, then, that the lovers of celestial mechanics will be in danger of idleness for centuries to come.

There might seem to be some fear that the asteroids would get quite out of hand and utterly outrun the powers of the calculators. But fortunately it is relatively easy (for a few experts!) to calculate the influence of Jupiter on an asteroid's motion, closely enough to predict its position in the sky within a few minutes of arc. With the aid of such tables we can be confident of finding the little planet again, even after letting it out of sight for 20 or 30 years. If we point our camera at the tabular position the asteroid may not turn up exactly at the center of the plate, but it will be safely *on* the plate and that is all we need to keep track of it.

Observation of the small planets in this fashion should, so far as can be seen, keep a few observers busy indefinitely. The course of their work is likely still to be enlivened by occasional discoveries. A number of asteroids are known which move in very eccentric orbits and approach the earth's orbit closely on one side of the sun but are far away on the other. When such a body comes to opposition at or near its point of closest approach, it may be tolerably bright. When in the opposite part of its orbit, even at opposition it may appear 100 or even 1000 times fainter.

TWO or three such planets are known which are so small that they can be observed only in the favorable years of close approach. There must be many more that are undiscovered, and picking them up at one of the rare occasions when conditions are favorable may interest the observer of the future, after the general run of the less interesting planets have been accounted for.

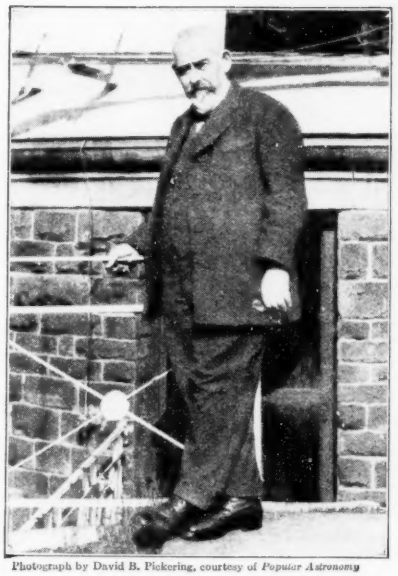
It is impossible to conclude without a word of enthusiastic admiration for the courage, skill, and devotion to science which enable Prof. Wolf and his associates, in spite of severe limitations in the finances of their observatory, to discover planets at the rate of a hundred a year, and moreover to make other important contributions to the advancement of astronomy which there is not space to relate.—*Pontresina, Switzerland.*



Photograph by David B. Pickering, courtesy of *Popular Astronomy*

DOUBLE 16-INCH CAMERA

Between the duplicate photographic refractors is a ten-inch finder for visual use



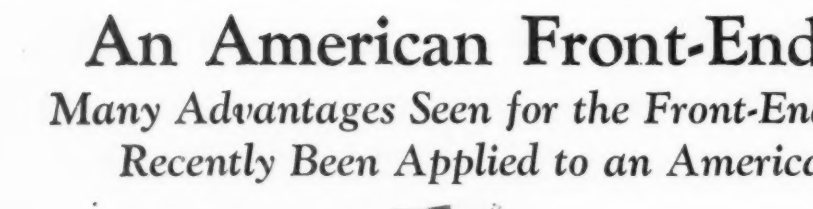
Photograph by David B. Pickering, courtesy of *Popular Astronomy*

PROFESSOR MAX WOLF

"... with iron-gray hair and beard, twinkling eyes beneath bushy brows .."—D.B.P.

An American Front-End-Drive Car

Many Advantages Seen for the Front-End Drive Which Has Recently Been Applied to an American Pleasure Car



THE CAR THAT "PULLS" ITSELF INSTEAD OF "PUSHING"

One model of the Cord automobile, the first stock American car to have front-end drive. Standing only 61 inches high, it is said to introduce greater safety and driving ease

INTRODUCTION by Auburn of the Cord front-drive automobile marks a new era in the automotive industry, in which America leads the world. While Europe took the first lead in the front-drive principle of automotive propulsion, limited production facilities and the smaller markets kept these cars from making great headway.

The history of the front-drive car in America is mostly a racing history, but it is replete with progress and accomplishment. Barney Oldfield as early as 1912 introduced the front-drive car to the American speedway, piling up many records with his car known as the "Christie," but it was left to Jimmy Murphy and Harry Miller to introduce the all-American front-drive car in 1924. Murphy died in that year, and the car was finished by Miller who entered it in the Indianapolis Speedway races Decoration Day, 1925. The car was driven by Dave Lewis and won second place (100.82 m.p.h.), in the fastest race ever held on the speedway.

Since that time the front-drive car has been a formidable contender in every major race in the country with such drivers at the wheels as Pete DePaola, Harry Hartz, Leon Duray, Cliff Woodbury, Pete Kreis, and Hepburn.

It is interesting to note the comment of Harry S. Miller on the reasons for his going over to the front-drive type racing car. He says:

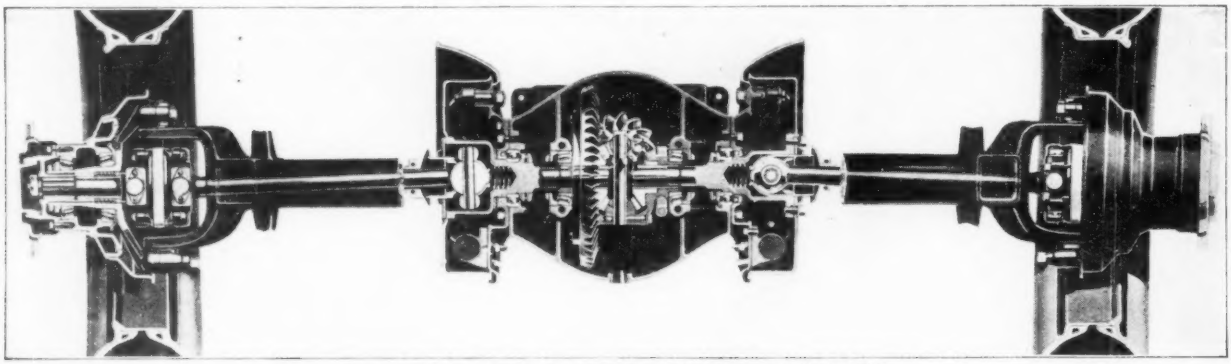
"I do not believe that the front-drive car is any faster than the rear-drive type. The reason why it can make better time on the speedways is that it is unnecessary for the drivers to slow down around corners, the skidding of the front-drive type being reduced to a minimum. The success of the front-drive car has been in the safety factors which it provides. It is a monumental record that in the five years front-drive cars have been used on the speedways there has never been a death due to one of these cars getting out of control."

While racing has its interest to the public, most car owners want to know what the front-drive has to offer them. The consensus of automotive engineers is that the chief contribution of the front-drive type automobile is, like that of the racing car, safety, with a second consideration of comfort, and possibly a third in economy. Three factors make possible the added safety of the front-drive car: its unusual lowness of design (it fairly hugs the ground), its lack of unsprung weight, and its "pulling" traction.

Some two years ago Harry Miller became associated with E. L. Cord, President of Auburn, in the production of a front-drive car. After eighteen months of experiments, with experimental cars on the roads day and night, the Cord front-drive car, built around the Miller patents, was announced.

PROBABLY the most noticeable feature of the new car is the closeness with which it hugs the ground, and yet it has a road clearance equal to most rear-drive cars. An ordinary size man standing beside it can look over the top. The phaeton-sedan, for instance, is only 61 inches high at the peak point, but even with this low construction head room is a full 38 inches. The average rear-drive sedan stands 70 to 73 inches with the same amount of head room.

Striking in appearance also is the long hood which is 46 inches in length, giving the car an unusually fleet and powerful appearance. The front fenders have an over-all length of 80 inches, and are the longest used on any production car. They are of the one-piece type and their long, sweeping lines add again to the fleet appearance. The



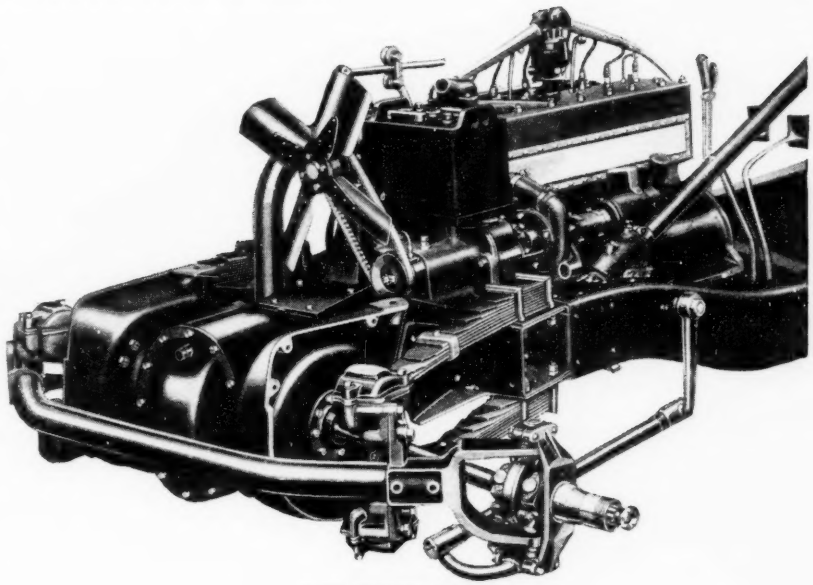
THE FRONT AXLE IS THREE QUARTER FLOATING

To transmit power to the front wheels and at the same time permit turning at a sharp angle presented a problem which the engineers finally worked out successfully by designing a special universal joint. Transmission, differential, and short drive-shaft are back of front axle

radiator is of the "V" type similar to the design used on Miller racing cars, although much larger, with the top line of the hood practically parallel with the ground. The body itself is streamlined throughout, with the rear seat on the same level as the front.

From a mechanical and engineering standpoint the front axle and method of drive are of chief interest. With the new Cord front-drive the engine, the transmission, the drive shaft, the differential, and the driving axle become a single power unit, thus adding to the efficiency.

The front axle is three quarter floating, and consists of a latitudinally bowed tubular member joining the steering knuckles. The propeller shafts are entirely separate from this, entering only at the ends where the steering knuckles are attached. The transmission and differential are all located directly back of the front axle and are mounted on the frame of the car, becoming sprung weight.



THE POWER PLANT

Engine of the new front-drive car. Here will be seen manner in which all except front tubular axle has been made sprung weight. Note special universal and method of steering

UNIVERSAL joints are provided in the propeller shafts, the two inner ones being of the Universal Products type, and the two outer ones of a special constant velocity type patented and used for the first time by Auburn in the front-drive car. It is this special universal joint that has made the Cord car possible. Heretofore, designers of front-drive cars have been hampered by their inability to obtain a universal joint which would give constant velocity to the front wheels when making a turn. Race drivers who have used the front-drive cars were under the handicap of having to make wide turns. Through the use of this new type universal joint the turning radius of the car has been reduced to 21 feet, or less than that of any rear-drive car of the same wheelbase.

Another outstanding feature of this front axle is that the king pin is perpendicular and that no transverse inclination has been necessary. This permits the use of a longer king pin and greater bearing surface, resulting in easier steering.

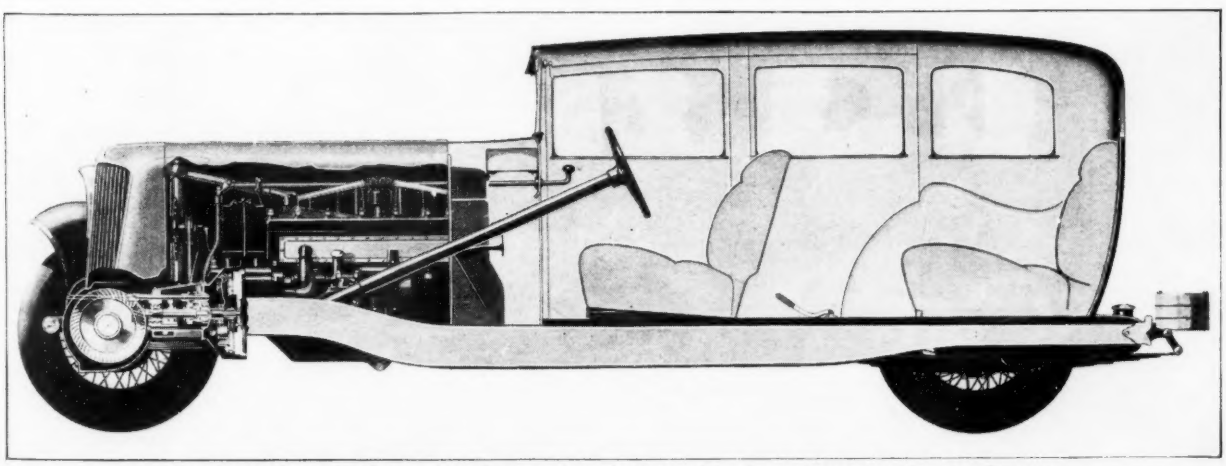
In detail, the car is powered by a straight-eight, 125 horsepower, Lycoming motor, which has been developed especially for this model. This engine is reversed from the usual type, the flywheel being in front, next to the transmission. The rear axle is of the I-beam type, and is approximately of the same weight as the front axle of the ordinary rear-drive car.

Brakes are Lockheed, 4-wheel internal expanding hydraulic, with a division of braking 60 in front and 40 in the rear. The emergency brake is operated by a hand lever well forward in the front compartment, and brakes on the rear wheels. The gear-shift lever extends through the instrument board and operates by a thrust turn.

The chassis frame has been made unusually strong, the channel stock being 7 by 3 by 7/32, and is unusually heavily reinforced by an X-cross bracing. Front springs are of the double quarter elliptic type, with the spring ends set in rubber. The rear spring is of the semi-elliptic type, and is built unusually rugged.

Through the elimination, at the rear, of the differential, transmission, and long drive shaft, it has been possible to design straight body sills, the elbow type of the rear-drive being unnecessary for the clearance of rear axle housings, which enables the rear of the body to be set much lower, the rear seat being on the same level as that of the front seat. The body of the car rides unusually low, and while the over-all height is considerably less than that of the rear-drive car, the head and leg room are greater. Average front head room is 38 inches and the rear 38 inches. The front seat is adjustable.

Four models are available, a Sedan, Phaeton-Sedan, Cabriolet, and a Brougham, all on a chassis of 137½-inch wheelbase.



PHANTOM VIEW OF FRONT-END-DRIVE CAR TO SHOW LACK OF BENDS IN CHASSIS FRAME

The Truth About Aviation Stocks

Basically Sound, the Aircraft Industry Has Suffered Severely From "Growing Pains," But Is Now Becoming Stable

By REGINALD M. CLEVELAND

AVIATION, that precocious infant among industries, which has leaped from the cradle to its majority—in performance at least—in less than half the time the human being requires to come of age, presents the anomaly of still suffering rather severely from growing pains.

In fact, in the last few months, these troublesome attendants upon growth have become severe. The industry, although fundamentally sound, and destined, in the belief of the writer, to have an even more important future than some of its rosiest protagonists have painted, is in a condition of confusion, of uncoordinated effort and, in many of its branches, of a very definite and disturbing over-production.

When, upon the impetus of the Lindbergh flight, and with the stimulation supplied by the gradual turning over of airmail operation by the Government into private hands, the industry quickly gained the immense momentum which has been manifested for the last year and a half, it was perhaps inevitable that it would build its house to some extent upon the shifting sands of dreams rather than upon the enduring rock of public service and patronage.

AVIATION securities, eagerly snapped up by an air-enthusiastic, if not truly air-minded, public, have come tumbling down in value. This does not refer to the spectacular events, the orgy of hysterical and distressed selling, which affected Wall Street in the closing week of October and saw aviation stocks tobogganing along with those of far longer established and more fundamental industries. I refer to a decline, less immediately impressive but more fundamentally disturbing, which took place, broadly speaking, all through the summer.

The performance of ten representative air stocks is reflected in the following table. The figures given are the high for the year and the low as of October 14, before the general avalanche of selling affected all stocks of whatever nature on the markets of the United States.

NEW YORK STOCK EXCHANGE

High		Oct. 14
20	Aviation Corp (Del.)	11½
104⅜	Bendix Aviation	65
37⅛	Curtiss-Wright A	27
48¼	National Air Trans.	20
162	United Aircraft	106

NEW YORK CURB EXCHANGE

48½	Aero Underwriters	29½
89⅞	Aviation Corp (the Americas)	40⅛
67½	Fokker Aircraft	35½
18	Roosevelt Field, Inc.	6½
78¼	Western Air Express	44½

A study of other aviation securities would reflect a like general tendency.

IT is not contended that all of the losses in values shown were justified. The worthy declined with the unworthy, due as much as anything, it may be, to an awakening on the part of the public to the fact that *gross* earnings from manufactures, plus those derived from the transportation of airmail and the irregularly profitable transportation of passengers, could hardly exceed, for the year 1929, the sum of 100,000,000 dollars out of which only *net* earnings would be applicable to an investment of close to 1,000,000,000 dollars.

It must not be supposed that, because the ratio of income to investment is so unalluring as yet for the industry as a whole, certain soundly organized and ably managed companies in the fields of both manufacture and transportation are not upon a healthy and profitable basis. The trouble has been that the sudden loosening of the purse strings of both the banks and the public, and their readiness to leap to the support of almost any or every enterprise which could be linked with aviation, has been far from an unmixed blessing. Altogether too many inexperienced persons and ill-conceived manufacturing and transportation programs have entered into the picture.

These must necessarily fall by the wayside. They are already doing so. Certain types of aircraft, notably the smaller planes unbacked by substantial performance records, remain unsold in hangars and stockrooms in many parts of the land. The state of overproduction is very definite.

Again, on the transport side of the picture, too many inexperienced operators, lured by the undoubted substantial profits which have been made in many instances in the transportation of airmail, have been led into the inauguration of passenger-carrying services. Some such services are already distinctly profitable. Many—one might almost say most—are not yet profitable, chiefly because the American public, while reading, talking, and thinking avidly of aviation, does not as yet take sufficiently to the air.

There can be but one result in a situation of this kind. The intelligently conceived, soundly managed, and well financed "strong" companies will survive. Those that do not have these characteristics, both in the manufacturing and in the transportation ends of the business, will cease to be. From the point of view of the investor it is a time for careful analysis and rigid selection in the purchase of aviation securities.

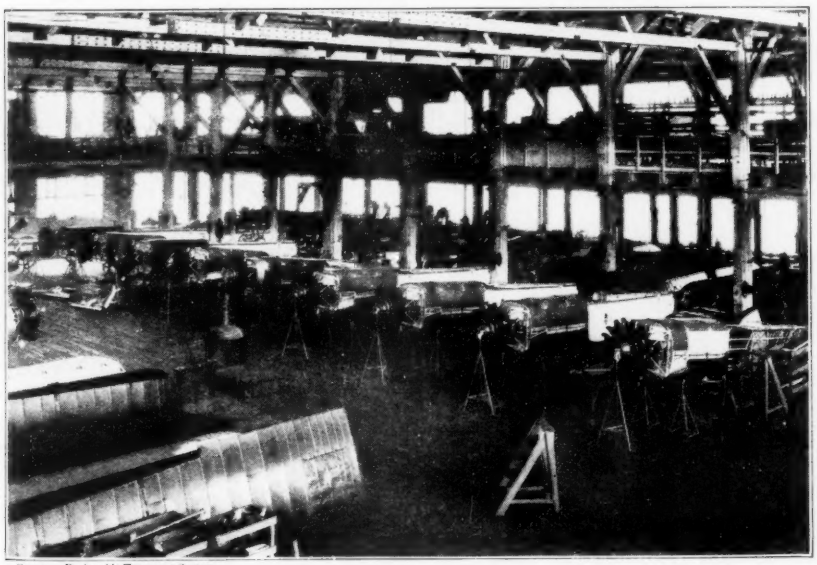
How far short the year 1929—in spite of overproduction in certain types—will fall, in comparison with the optimistic estimates which marked the beginning of the year, may be gathered from an examination of the comparative figures. The early estimates set the probable plane figure for the year at 12,000 to 15,000. There were actually manufactured in the first six months of 1929, according to the figures of the Aeronautical Chamber of Commerce, a total of 3381 airplanes (including 527 for military use) and 3826 engines (including 551 for military use).

THESE figures, which represent 93 percent of the industry, do not indicate a total production of planes exceeding 6500 to 7000 for the year, or of engines in greater number. The figures may be compared with a total representing 95 percent of the output of the industry for the year 1928, according to the Department of Commerce, of 4345 planes and 3496 engines—in both cases including the military.

It is estimated, according to statistical studies made by Air Investors, Inc., that 75 percent of all the industry's activities are carried on by less than ten companies. On the other hand, the Chamber of Commerce lists 278 companies claiming to be aircraft manufacturers. Of these it is possible that 200 will have manufactured some aircraft during the year. If 7000 units be taken as the total, this will bring an average production of 35 planes per manufac-

turer, obviously not a basis upon which profitable manufacturing could be carried on. The fact is that a handful of companies will of course have very much larger production than this average and that most of the rest will no longer be in the aircraft manufacturing business.

Looking to the sound future of aviation, it is probably very well indeed that the manufacturing estimates for 1929 will not be reached, for there are not pilots enough to man any such fleet of planes. On June 30, 1929, the number of licensed pilots was only 90 percent of the number of planes which had been licensed and identified by the Department of Commerce. In the 12 months ending on September 1, 17,350 applications for student pilot licenses were received by the Department. Of these applicants only 45 percent passed the physical test, completed their flying courses, and applied for pilot licenses, and only 26 percent, or 4570, received pilots' licenses. On September 1 there were 6891 licensed pilots as against a total of not less than 8000 planes.



Courtesy Boeing Air Transport System

ONLY THE STRONG CAN SURVIVE

Intelligently conceived, soundly managed, and well financed aircraft manufacturers will remain in the industry and will eventually show profits. All others will fall by the wayside

No one with the interest of aviation at heart could wish that licensed planes or unlicensed planes, for that matter, should be flown by unlicensed pilots. The very real and menacing bugaboo of aviation is the unlicensed pilot and the unlicensed plane. The leaders of the aviation industry quite rightly urge that the public, in reading the daily toll of airplane fatalities, should draw the sharpest kind of a line of demarkation between the crashes in which untrained personnel and unfit equipment are involved and the very small and constantly diminishing number of accidents involving trained personnel and proper equipment. It would indeed be hard to put too much stress upon this contrast, and one need only learn of such records as that, for example, of Western Air Express which has operated its passenger-carrying planes 3,200,000 miles without an accident, to realize how safe properly organized air transport can be.

IT goes without saying, then, that aviation could hardly be benefited by a great surplus of planes without an adequate number of trained pilots to operate them. It will be of vital importance to the industry to emphasize to a much larger body of men and women during the coming year the training points required by the wise provisions of the Department of Commerce.

In addition to overproduction, and to the deflation of security values, aviation has been forced, during recent months, to face the swallowing of two rather bitter pills: First, the probable reduction of the army and navy appropriations for aircraft by three million or four million dollars each; and second, a reduction in the rates paid to operators for the carrying of the airmail, or, at least, a very considerable readjustment of those rates.

The outlook for the industry, however, in the view of the writer, is a most favorable one. The recent period of readjustment, of that settling of the yeasty brew which inevitably follows such unusual expansions, was only to be expected. Painful as the process may have been, for individual concerns and for those persons who sought to capture a pot of easy gold at the end of the aviation rainbow without due analysis of its spectrum, it can only lead to a more substantial and a better founded structure.

There is no justification for pessimism in regard to aviation. From the point of view of manufacture, the strong companies are carrying out programs carefully and efficiently planned and buttressed by back-logs of orders which will keep their plants busy 80 to 90 percent of capacity for many months to come.

The most farseeing of the strong companies are reaching out well articulated tentacles into the export field. It is a field of immense promise, and no less an authority than Daniel Guggenheim, donor of 5,000,000 dollars to the advancement of aeronautics and of many times the value of that amount in the stimulation wrought by the Fund which he founded, predicted in a comprehensive article in *The New York Times* recently that aircraft and their accessories would come to be major factors in the export trade of the United States.

POWERFUL interests, heretofore outside or only remotedly connected with the aviation industry, have manifested their more active interest by investment in aviation projects. Notable among the recent moves of this sort has been the formation by the General Motors Corporation, acting with the Fokker Aircraft Corporation—of which it owns practical control—of the American Dornier Corporation, to bring the manufacture of Dr. Claude Dornier's giant flying-boat types to the United States.

Pan-American Airways, after Colonel Lindbergh's latest line-charting trip, may be expected rapidly to bring the circle of the Caribbean into the scope of its expanding passenger transport. Meanwhile it has arranged a 30-hour service with air-rail hook-up between New York and Havana, and looks for such an influx of business on the Miami-Havana route that it is contemplating the use of the new giant Fokker *F-32* landplane for this popular flight.

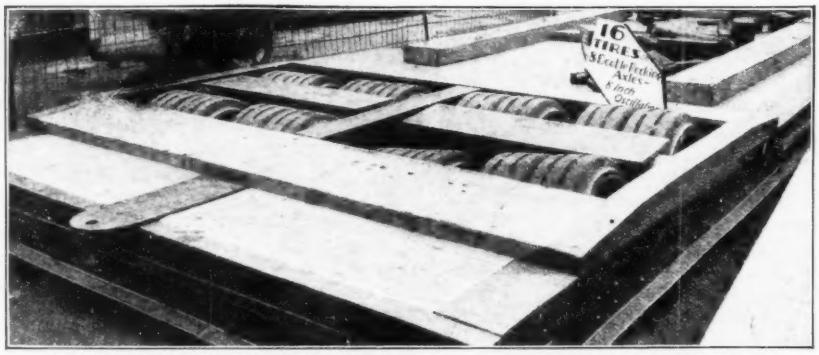
Universal Air Lines and Western Air Express, acting together, will fly passengers from Atlantic to Pacific in about 30 hours.

Meantime, the dirigible *R-101* performs even better than had been expected in her early flights in Great Britain, and the "ring" has been laid for the first of the two super-dirigibles for the navy in the world's largest building, the new hangar of the Goodyear Zeppelin Company at Dayton.

Aviation, then, is very far from moribund. It is a strong young tree which has made too much wood for its own health. Some of that wood has been rotten, some of it has been merely superfluous. A drastic pruning has been in operation. The result will be a healthier growth.

Giant Trailers Protect Pavements

TO keep pace with the trend toward larger and heavier construction equipment, such as steam and electric shovels and draglines, trailers of a new type are now being used to transport such equipment. Laws to prohibit the movement of heavy equipment under its own power have been passed by a majority of municipalities, states, and counties. In order to prevent unnecessary damage to paved and surfaced roads, many highway authorities insist that large and heavy equipment must be moved on rubber-tired wheels. Even when using rubber tires, the street or road is likely to be damaged if the load is not equalized properly by the use of auxiliary wheels.

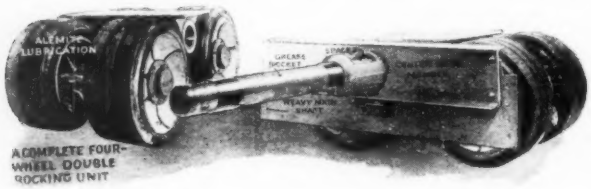


TRAILER FOR TRANSPORTING HEAVY CONSTRUCTION EQUIPMENT

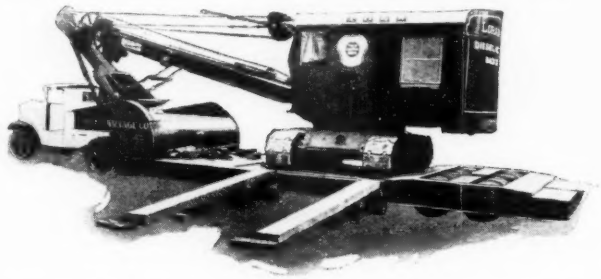
In order to move heavy machinery without crushing paved or surfaced roads, the equipment is placed on a trailer equipped with 16 solid rubber tires on wheels mounted on rocking axles

The trailer illustrated here has a capacity of 100 tons, and by means of eight double-rocking wheels, the load is equalized sufficiently to transport the heaviest equipment now in use without damaging the pavement or highway surface. Sixteen solid rubber tires are provided on eight wheels mounted on double rocking axles which automatically distribute the load over all of the tires in such a way that the wheels can conform to the variations in the surface of the road. This eight-wheel assembly is used on the rear of the truck where most of the weight is centered. The front part of the trailer is supported by a heavy duty "goose-neck" attachment, which facilitates hauling.

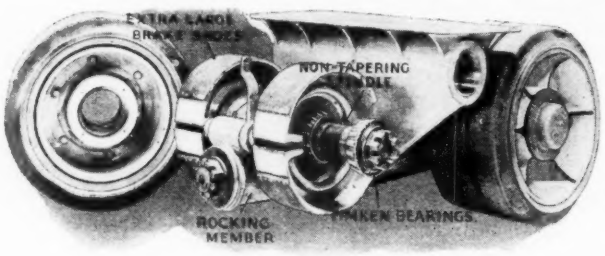
Each four-wheel rocking assembly functions as a complete unit, although pivoted on the heavy main shaft or axle. Between each pair of wheels is a rocking member composed of an electric-steel casting with bronze bushings, attached to a heavy steel shaft, which provides the flexibility needed when a wheel encounters a minor obstruction or depression in the road. Each wheel is mounted on a non-tapering spindle, equipped with tapered roller bearings. Extra large brake shoes are provided. The mechanical parts are all lubricated by grease gun, and every axle is so shaped as to provide a grease pocket or reservoir.

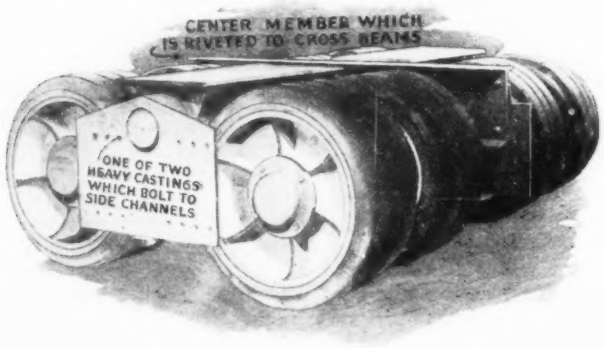


In the illustration at the top of the page, showing the rear section of a large-capacity trailer, the flexibility of the wheels is shown clearly, as one wheel passes over a depression in the road. The method of loading a large Diesel-electric shovel is shown in the picture immediately below that of the trailer. By means of heavy planks placed to form ramps, the shovel moves under its own power to take its place on the trailer. The powerful truck which provides the means of locomotion is dwarfed by its massive cargo.



At the left is shown a four wheel double rocking unit detached from the axle. Note the grease pocket on the main shaft. At the lower right, a wheel assembly is shown with two of the wheels removed. The outer bearing and nut have been replaced to illustrate their position when assembled. Control of the trailer is facilitated by the extra large brake bands. At the bottom of the page the detail of the eight wheel assembly is illustrated. Two heavy castings bolted to the side channel beams provide housings for the ends of the main shaft or axle. The trailer is suited to a wide variety of applications, depending upon the shape and nature of the equipment to be transported, the length of the haul and local factors.





¶ *When a graceful bridge serves as a new tie to aid in cementing existing bonds of friendship between two great countries, it takes on an economic significance aside from its engineering features. Such a bridge is the Ambassador Bridge from Detroit to Windsor, Canada, an article on which is coming soon.*

"Fingerprinting" Autos

BY means of an identification system recently perfected by Deputy Sheriff Dave Chapman of Los Angeles County, California, criminals and felons can be apprehended under certain circumstances by the imprint of their automobile tires. From a scientific study of the tire imprint and comparisons with marks on record in the Sheriff's office, it is possible to determine the make and size of the tire, which wheel it is on, and the approximate type, load, and speed of the suspected car at the time the felony was committed.

When suspicious-looking tire marks are discovered near the scene of a crime, a try-square is placed on the ground beside the marks and measurements and photographs are taken. This data is compared with office records of the 450 different kinds of tire-tread patterns now in use. After determining the make, size, and position of the suspected tire, officers watch for cars having the distinguishing tire or tires.

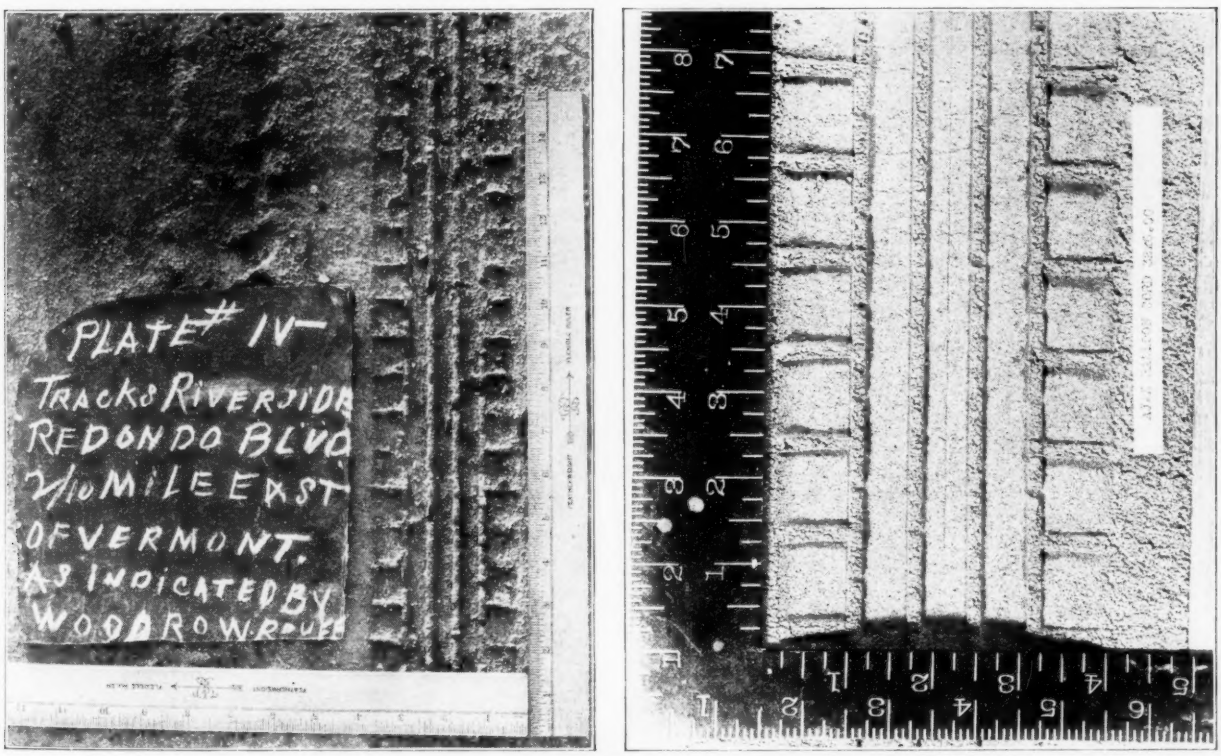
By means of the new system of identification, several professional chicken thieves were apprehended recently near Los Angeles. When confronted with the unexpected circumstantial evidence against them, the thieves confessed and were sentenced.

COMPARING TIRE PRINTS

Deputy Sheriff Chapman calculating similarities between imprints and blueprints

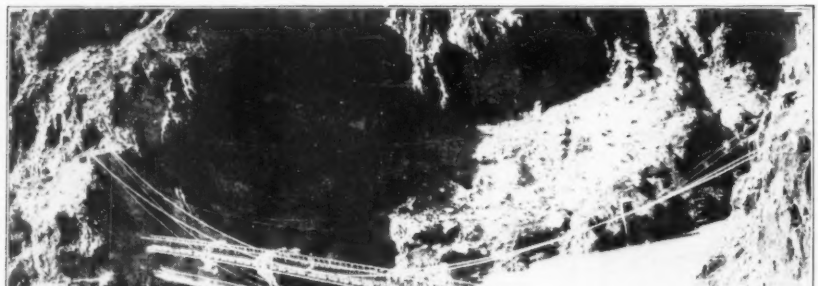
HELD FOR INVESTIGATION AS A SUSPICIOUS CHARACTER

Branded by the distinguishing tread mark of its right front tire, this car was apprehended by the authorities after it had participated in a long series of thefts in southern California



MEASURING THE TELL-TALE "FINGERPRINTS" LEFT BY AUTOMOBILE TIRES

To measure tire treads accurately from photographs would be a task for an expert mathematician who could compute the measurements from the height of the camera, et cetera. By using rulers or a try-square, the exact measurements can be photographed



SUSPENDED ON SLENDER THREADS

The tourist to the Grand Canyon may now take a train to the region, cross the new canyon bridge safely afoot or on horseback, and then proceed on his journey via another railroad

Bridging the Grand Canyon*

Intrepid Engineers Anchor Cobweb of Steel to Gorge's Precipitous Walls

By KIT McKENZIE

ACROSS the Grand Canyon of the Colorado, at the foot of the Bright Angel Trail, engineers of the National Park Service and Forest Service have spun a bright new cobweb of steel upon which the tourist may cross safely from the south rim to the north and the great Kaibab Plateau. Adventure and danger were the warp and the woof of its building; its opening last year represented a triumph of man over nature in the face of appalling obstacles.

Years ago, when men first crossed the canyon, they swung dizzily through the air on a single cable, high above jagged granite rocks and the swift and dangerous river. Later, the first straggling tourists crossed on a swaying suspension bridge, built by the National Park Service in 1920, the first span to be thrown across the chasm and the only safe means of transport in a stretch of 300 miles.

The need of a new bridge became apparent in 1927, when the Kaibab Trail was under construction, and funds from the Roads and Trails Fund of the Service were made available for its building. The old bridge had served its purpose well, but it was considered too light and too elastic to accommodate safely the increasing number of visitors to the Park. It swayed to the rhythm of the pack train, and winds driving up and down the canyon at a terrific rate tossed it about so violently at times that crossings were impossible. More than once during a violent storm it was turned completely over.

In designing the new bridge, unusual factors had to be considered. Not the least of these was the difficulty and expense entailed in transporting materials from the rim of the canyon to its floor, an airline distance of about four miles and a drop in elevation of nearly 5000 feet. The construction of a cableway was considered, but after careful study it was decided that a pack train would be more economical and satisfactory.

THUS down a narrow, zigzagging defile, seven and a half miles in length, sturdy little donkeys packed the bulk of the materials and supplies used in the construction of the bridge. Three months were required to carry the main part of the load from Yaki Point to the construction camp, pitched at the junction of the roaring Colorado River and Bright Angel Creek.

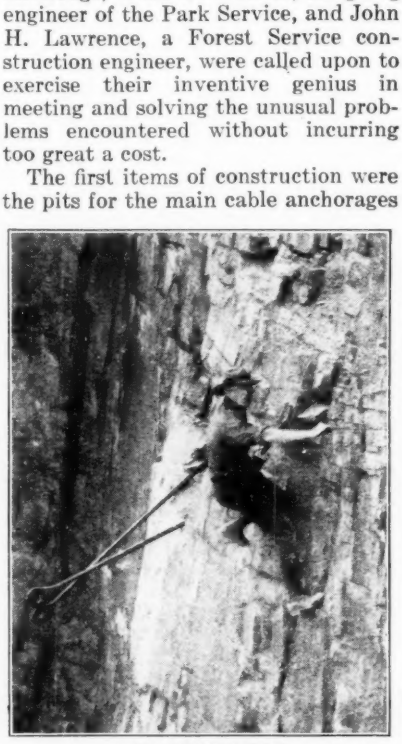
Use of the pack train placed a limit upon the size of the pieces used in the bridge and affected its design. Only pieces ten feet or less in length could be transported by the animals and the weight each could sustain was limited to 200 pounds. Each of the main cables, of which there were eight, was 550 feet long and weighed over a ton. These were carried down on the shoulders of 42 men, mostly Indians, each man supporting a weight of about 50 pounds. The wind cable came in one piece, 900 feet long, and was transported by means of "go-devil," or heavy sled of original design.

Drawing up the actual plans and specifications of the bridge presented peculiar difficulties. The distance to be spanned measured 500 feet between supports with an allowance of five feet for width, since a narrower bridge would be likely to interfere with the passage of a loaded animal and, if the bridge were wider, there would be more opportunity for the animals to turn around and cause confusion in the line of a pack train. In spite of these limitations, it had to be strong enough to carry a train of any length; that is, a string of animals completely covering it from end to end.

POSSIBLE congestion due to inexperienced riders had to be taken into account so that the structure would hold even in a stampede. It had to be rigid so that there would be no possibility of a swinging or jarring motion that would cause fear on the part of tourists. The rushing winds of the canyon had to be provided for; the bridge must remain staunch against transverse wind stresses that might cause it to turn over as the old one had done.

The new bridge is the longest ever built by the Park Service, the usual run being from 100 to 300 feet. Therefore the engineers, Chief Engineer F. A. Kittredge, Ward P. Webber, designing engineer of the Park Service, and John H. Lawrence, a Forest Service construction engineer, were called upon to exercise their inventive genius in meeting and solving the unusual problems encountered without incurring too great a cost.

The first items of construction were the pits for the main cable anchorages



A TICKLISH JOB

In a saddle suspended from a transverse cable, engineer Lawrence anchors a wind cable to the precipitous canyon wall

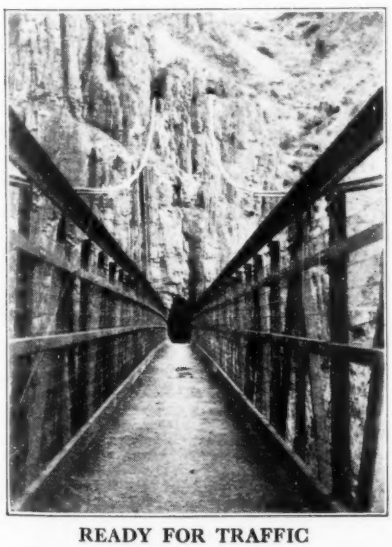
*Reprinted by permission from *American Forests and Forest Life*. Photographs courtesy Department of the Interior, National Park Service

and cable supports. On the north end the upstream pit was sunk 14 feet into solid rose granite; the downstream pit was drilled four feet into the rock of the canyon wall.

Since the new bridge was to be located on the site of the old, but at a slightly higher elevation, and the old bridge was to be in uninterrupted use during construction of the new, all excavation work had to proceed cautiously for fear of dislodging the old supports. Only light blasts were possible and certain parts of the original bridge had to be braced to insure safety. The anchorage steels were deeply imbedded in solid concrete and farther down the canyon wall, concrete cable supports and the north abutment were constructed under conditions that were equally hazardous.

BECAUSE of the higher elevation of the new bridge, the trail approaches at both ends had to be altered. At the north end this was fairly simple. A spiral was constructed beginning at the grade of the old abutment, swinging upstream and to the east, then back to the new bridge. This permitted using part of the old trail and gave an easy, attractive approach to the new structure.

Excavation work was simultaneously under construction at the south end of the bridge and here more serious difficulties were encountered. First of all, the location of the new cable supports was so near the old that making open cuts in the rock for passage of the main cables would seriously endanger the security of the old bridge. To obviate this, small tunnels had to be drilled back to a safe mooring through the solid rock. The canyon wall in that place was of a mica schist formation—very blocky—and the concrete works of the old cable anchorage lay directly above each new cable tunnel. Consequently the tunnels had to be excavated by hand. They measured about two and a half feet in cross-section and were 17 and 11 feet long.



READY FOR TRAFFIC

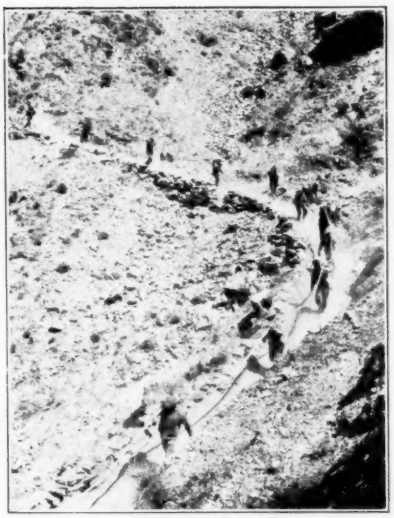
The completed bridge and the tunnel approach 5000 feet below the canyon rim

Because of the overhanging canyon wall, creating a danger from falling rocks, and other factors, a tunnel had been decided upon as the safest approach to the bridge from the south. Its construction was an achievement in itself. It is 105 feet long, 10 feet high and six feet wide. Workmen doing the excavation were inadequately equipped with tools, two old air compressors being all that were available for work on the entire structure. Half the time these operated so poorly that both had to be used to run one small jack-hammer. To speed up construction, two eight-hour shifts of workmen operated in the tunnel day and night with the work in progress at both ends. The arduous nature of the task can be imagined from the report of Engineer Webber, a part of which follows:

"An average of seven hours was required to drill a round of seven holes," he wrote, "the eighth hour being required for loading and blasting. One round would 'pull' from two to four feet, depending on the material encountered. All tunnel workers had to wear respirators and goggles as a protection against rock dust, and owing to the extreme danger of some of the rock over the portal caving in, it was necessary to resort to timbering and, later, to concrete the portal."

THE hoisting of the main cables and their adjustment signaled the beginning of the bridge proper. When these had been secured, an engineer and a rigger swung out over them in fragile-looking swing seats called "bos'n" chairs to measure and mark them for the hanger cables. The transoms, each consisting of a floor beam and two verticals, were then trundled out onto the old bridge and attached to the hanger cables at positions corresponding to those they were to occupy in the new structure. Then the entire group was hoisted by means of a tackle and adjusted in place by a rigger.

The framework of the bridge having been spun, there remained the adjustment of the heavy floor beams. These were riveted together and swung directly onto the bridge by means of a special cable, or high-line, strung across the canyon above the new structure. Large and unwieldy, these beams were perhaps the most difficult parts of the bridge to place. The riggers had to "ride the steel" and make a flying connection. As fast as the sections were brought up and placed, the floor plates and guard angles were brought onto the bridge and bolted into their places. Then stiffening trusses were laid and riveted together in a continuous piece to give the greatest possible rigidity.



A PYTHON-LIKE CABLE

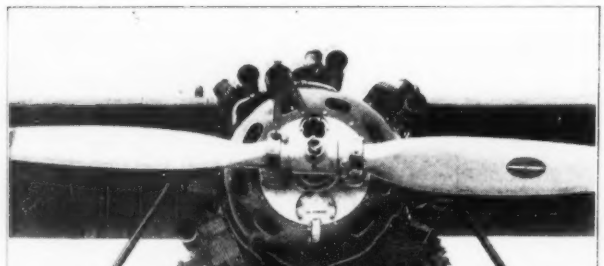
From the canyon rim down the Yaki Trail a cable is carried on men's shoulders

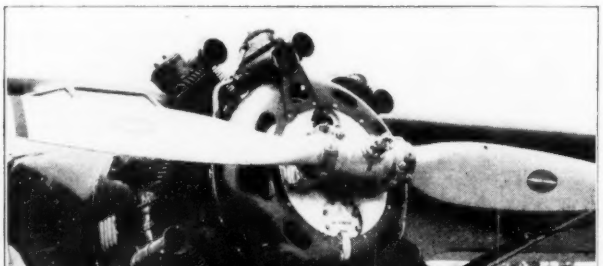
The next task was to adjust and anchor the cables designed to brace the bridge when swift storm winds ride the canyon. The anchorages of the wind cables, one on each side of the bridge, were placed at an angle of 26 degrees below the bridge so that the cables would brace it not only against transverse currents but also against winds tending to lift and toss the floor. Placing the anchorages in the sheer rock lining of the canyon was a task both dangerous and difficult. The jack-hammer operator who drilled for the guys was lowered by a rope over the precipitous wall and hung in a sling from two ropes, 125 feet below the rim of the canyon, with 70 feet of rock, in a sheer drop, below him to the river.

TO afford a more secure foothold on the bridge, a two-inch surfacing of screened gravel, sand, and cold asphalt emulsion was laid on the floor of the structure. Other finishing touches, such as the wire fence and guard rails on the sides of the bridge, were then added to complete the structure.

It is a tribute to the engineers that in building this great bridge across so awesome a chasm not a life was lost. Even the patient, plodding pack animals came through the ordeal safely. There are 122 tons of steel and other materials in the bridge; not one piece was dropped into the river far below.

¶ *"Will the business man fly?" is the subject of a coming article which points out many pertinent facts that tend to show the gradual but inevitable adoption of the airplane by business on a wide scale.*





TWO STRIKING VIEWS OF THE PACKARD DIESEL ENGINE FOR AIRPLANES

The Airplane Diesel in 1940

The Many Advantages of This Simple Power Plant Point Toward a Great Increase in Its Use

By ROSWELL H. WARD
Managing Editor, Motorship

IT is a far cry from the cumbersome stationary Diesel engines of past decades, deep-rooted in massive foundations and cumbrously wrought in cast iron, to the alloy-steel perfection of the present day airplane engine, eloquent of speed, power, and *light weight* in every line and contour!

However, it has been this technical gulf, this wilderness of abstruse metallurgy, combustion phenomena, and stress analysis which the Diesel engineer has had to bridge in essaying the development of a practical aviation Diesel engine.

HOW successful these explorations have been is evidenced by the remarkable evolution of light-weight, high-speed Diesels in recent years. In the 11 years since the World War, the weight of the lightest Diesel engine has been reduced from about 65 pounds per horsepower to less than three pounds per horsepower, and the speed, which in the past was supposed to be definitely limited in the Diesel engine, has been increased from about 750 revolutions per minute to well over 2500! And at least two types of Diesel engine—probably more—have actually flown in heavier-than-air machines, to say nothing of the Diesels installed in the British dirigible *R 101*, which, at the time of writing, has been successfully flown in various tests. (See photograph on page 38.)

Diesel aviation progress has reached a transitory stage, where its advocates, gratified at last to see a Diesel engine actually in flight, have inclined to over-enthusiasm in prophesying the scope of its immediate application.

The air transport executive, confronted with the necessity of making an impartial technical judgment, has reacted to this over-enthusiasm in a way well expressed in these columns heretofore, (See SCIENTIFIC AMERICAN for September, 1929), and has raised a series of very sound questions which deserve to be answered by careful analysis rather than by argumentative advocacy.

Foresight

THE question of Diesel engines for airplanes is one that is of absorbing interest to everyone following the progress of aeronautics. The accompanying article was prepared to supplement the one entitled "Is the Airplane Diesel Practical?" presented in our issue for September 1929, and in doing so, the author placed the time of his description ten years in the future. But this is no "futuristic" story based on a vivid imagination. It is a straight-forward presentation of facts that are apparent to all those with eyes to see, amplified by a thorough knowledge of the subject gained through close association with the men in the Diesel field who have been doing things.

—The Editor.

No one should be more cognizant of the scope and limitations of the aviation Diesel engine than the Diesel engineer. The basic problems in the construction of high-speed Diesels have been solved, but a tremendous amount of detailed development work must still be done to insure the future of the airplane Diesel.

There are metallurgical, production, and theoretical design problems to solve. In its present form the aviation Diesel can undoubtedly become in a few years an important *supplement* to the airplane gasoline engine, especially in large airplanes and seaplanes and in dirigible balloons.

Further to present a graphic picture of exactly how the aviation Diesel compares in actual flight with the gasoline engine, we will be over-conservative and estimate a lapse of 10 years, from which point of time we will visualize the attainment of the widespread use of airplane Diesels. Engines such as these will undoubtedly be in extensive use long before 1940, but we will jump ahead a decade in our prophetic study in order to depict the perfection of development which will probably be realized long before that time.

ANY airplane—whether large or small—is subjected to a daily inspection, a careful grooming and scrutiny which has in its routine attention to detail few parallels in any field of engineering or transportation. Skilled mechanics go over the engine, riggers examine the wings and control surfaces, keen-eyed inspectors check their reports and repair work with great care, and finally, the operations executive carefully scrutinizes the reports of both ground engineers and

pilots. A race horse or a fine motor car gets no more attention on the eve of a great contest than does a transport airplane in the course of everyday service.

Let us follow the inspection of a 1940 Diesel "motorship of the air" such as we foresee, and determine wherein it differs from the present rites of those who serve the gasoline driven airliners. As the cowling is removed from one of the six-cylinder "in-line" air-cooled Diesels, (a cowling which leaves the upper part of the cylinders exposed and directs the air stream along the cooling fins), our attention is drawn to its extreme simplicity.

There is no carburetor or intake manifold; there is no electrical ignition, no magneto or spark plugs; there is only a small pipe to the head of each cylinder, and there is only one valve in each cylinder head, from which a small "exhaust deflector" projects.

THE ground engineer does not have to adjust the carburetor; he does not have to worry about the intricacies of electric ignition or fouled spark plugs; when there are valves to be ground, there is just one, which takes care of both the air intake and exhaust in each cylinder.

The engineer is dealing with the highest expression of man's battle to wrest heat energy from petroleum—the most efficient heat engine in existence—and mechanically by far the simplest. With a compression about twice that of the ordinary aviation gasoline engine, this Diesel draws in the outside air through the single valve in the head, compresses this air to a temperature sufficient to ignite the charge of fuel-oil sprayed in from a little nozzle in the top of the cylinder, and when the power stroke is complete, exhausts the spent charge through the same valve in the cylinder head.

(This description is for a "four-stroke-cycle" engine; there will be numerous other types using the "two-stroke-cycle" and highly original valve and structural arrangements, but for descriptive purposes this type of engine has been selected as representative of American practice as now foreseen.)

Spared carburetor and magneto work, and with his valve inspection reduced to half, our mechanician, however, is up against some purely Diesel problems. He will have to remove and inspect the fuel nozzles in each cylinder head and, while the engine is running, will have to assure himself that the fuel pump which supplies a minute quantity of oil to each cylinder is functioning properly in its split-second work of metering and pumping.

THIS fuel pump is one of the points often criticized by those who question the reliability of the Diesel. It is the perfect embodiment of precision workmanship, is ground and honed so that its plungers fit to extremely close limits. This, in theory, is a knotty production problem. However, in actual practice, certain well-designed types of fuel pumps have shown themselves to be almost fool-proof. The precision of construction and the number of working parts in a well-designed Diesel fuel pump are much less a problem, comparatively speaking, than that of producing electric ignition magnetos and distributors, intricate operations which are taken for granted today.

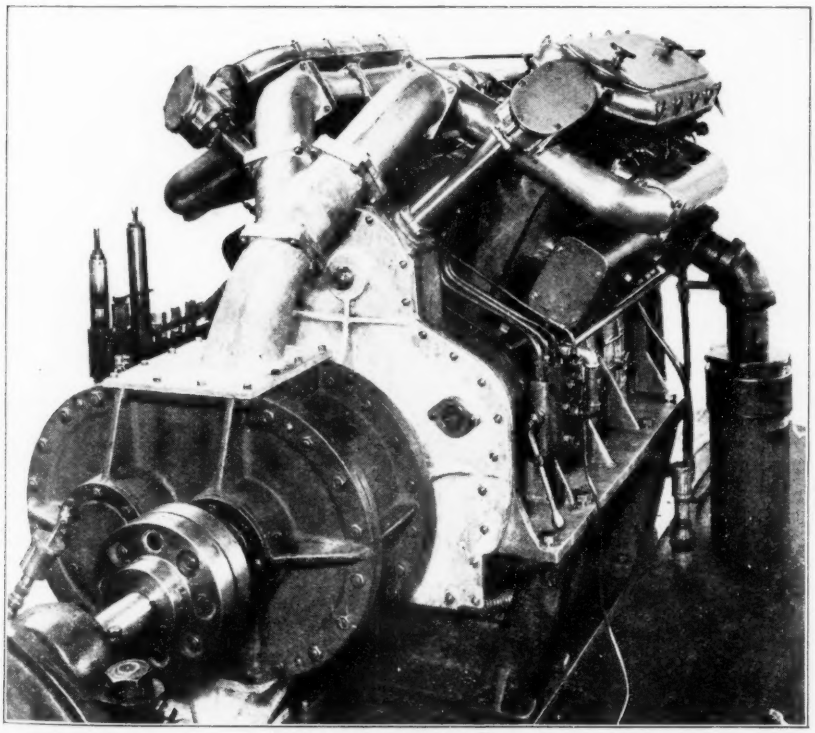
DESIGNER AND PILOT

Left: Capt. L. M. Woolson, designer of the Packard Diesel, and Walter Lees, pilot

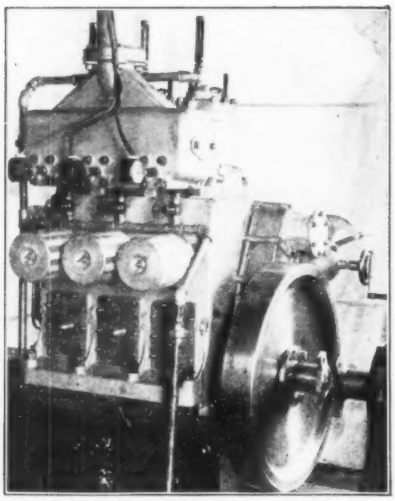
Most American difficulties with experimental fuel pumps have, to speak bluntly, been due to poor design, or to poor production engineering. As the demand for this type of equipment increases, this problem will be overcome, as many other more intricate ones have been solved.

WE mentioned above that our mechanic was working on an engine with *twice* the compression of a gasoline engine. This presents another difficulty—that of starting. At present an electrical starter capable of turning over a Diesel engine is much too big and heavy for airplane use. However, we may expect that this trouble will be mastered by releasing the compression in several cylinders and using an electric starter, or by some other expedient—it even having been whispered that a small gunpowder cartridge is used for starting on one American aviation Diesel!

Now that the inspection of our "air motorship's" power plant is completed, here comes a tank truck with fuel for it. To one reared in the atmosphere of high-test aviation gasoline, volatile benzol compounds, and so forth, the calm superiority of the "grease neck" who smokes a cigarette as he pushes the hose into the oil tank is somewhat uncanny; but he is dealing with fuel oil of about the consistency of ordinary furnace oil—non-volatile and unaffected in its condition in the fuel tank



THE STEARNS DIESEL ENGINE



Courtesy American Machine and Foundry Co.

MOREN-BRONANDER DIESEL

Estimated horsepower of this engine, at 1200 revolutions per minute, is about 30

by changes of altitude—it will not produce inflammable vapors in a rarefied atmosphere, or on the ground.

This new generation of "Diesel bred" airplane mechanics commit another heresy in the eyes of the old timer: they start the engine while the fueling operation is going on! But the exhaust from the cylinders is clear and carries no flame—and the ignition point of the fuel oil is so high that one could even spill some of it on the engine and it would not actually burn—something to be thought of in the event of a crash, and certainly a condition which makes for greater ease, safety, and time-saving in servicing the plane.

The scarcity and possibility of contamination of fuel oil at airports around the country is also one of the criticisms of the aviation Diesel. But what can one expect? Just as American industry will build reliable fuel pumps in quantity and develop workable methods of starting, so will the oil industry respond with more easily available supplies of Diesel fuel. Long flights have already been made on ordinary furnace oil and oil of that type is almost as easy to get as gasoline in this day of household and industrial oil burners!

IT was not necessary for the mechanic to start the engine to "warm it up," as is done now with all gasoline aircraft engines. All aircraft Diesels are "cold starting," the heat of the first compression is enough to ignite the fuel, and a Diesel airplane can take off immediately the engine begins to turn over, although if not necessary, it is just as well to let it "tick-over" on the ground for a short time. However, in cold weather operation, in an emergency, or in military service, this characteristic is something to be considered.

Now that we have entered the cabin and have waved farewell to those who watch our pilot "lift" us off the field with the calm mastery of these picked men who handle transport aircraft, we notice a smoothness of flight and an absence of that vibration which is sometimes felt in airplanes. This elimination of vibration is due to the fact that the engine does not run as fast as a gasoline engine. In order to get the weight of gasoline engines down to their present basis, it has been necessary to increase the power by increasing the speed, usually to 1800 or up to 2200 revolutions per minute. The Diesel will operate normally at about 1200 revolutions per minute, which is a much more efficient propeller speed then the higher figures mentioned.

We may smoke in our cabin, just as the service man did and for the same reason, and our guide points out to us that spilling of the fuel, in event of a forced landing, would not set the plane on fire. A comforting thought for those with lively imaginations!

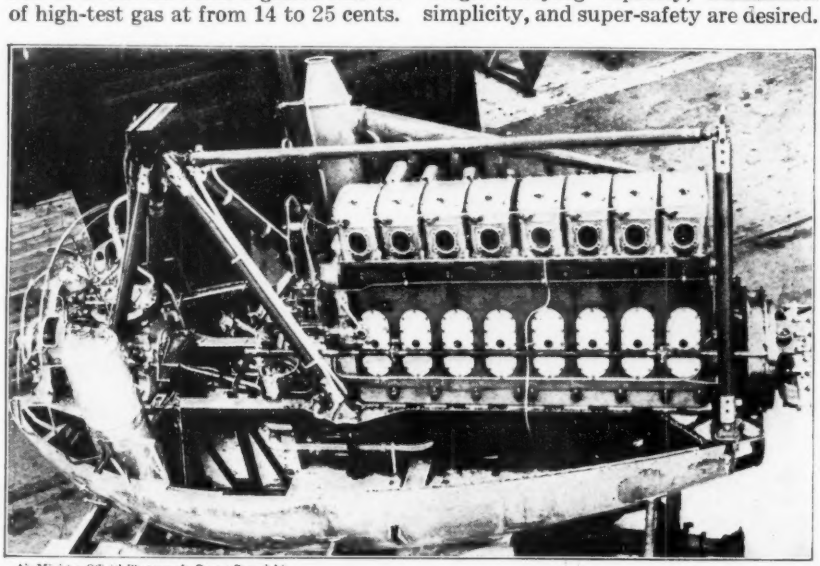
AND another characteristic is pointed out: Due to the fact that the fuel does not form a volatile mixture until it enters the cylinder, there is no chance of a backfire into the intake manifold as sometimes happens with gasoline engines. And the position of the airplane exerts no effect on the fuel supply; the fuel pump and the fuel nozzles will work as well upside down as they will in the upright position.

We look over a report on the cost of operating these Diesel-engined airplanes. The engine costs more than a gasoline engine, and will until quantity production is achieved. The fuel cost is considerably less than that of a gasoline engine. We are using Diesel fuel at about six cents a gallon instead of high-test gas at from 14 to 25 cents.

But this is not the main argument for the economy of the Diesel. For a given combined weight of fuel supply and engine—provided that the weight of the Diesel engine is somewhere near that of the gasoline engine, (on this point more will be said)—the flying range or the carrying capacity of the Diesel-engined airplane is greater than that of the airplane with a gasoline engine. This is especially true for flights of 500 miles and over, when fuel economy becomes a large factor. Estimated conservatively, given the conditions outlined above in flights of this type, the cruising radius, or the weight-carrying capacity of the Diesel-engined airplane would be from 20 percent to 30 percent greater than that of an airplane powered with a conventional type of air-cooled gasoline engine, such as we know today.

THE condition made above in regard to weight is the prime reason we have conservatively set the date of the general use of aviation Diesels some years ahead. The aviation Diesel is now considerably heavier than gasoline engines—and this increased weight offsets most of its other advantages. However, as the weight is reduced, the fuel economy will help to make up for what weight handicap is left, and the Diesel will first become an important *supplementary* form of power to be used in large aircraft for long flights.

It is difficult to foresee what would happen if a Diesel were produced as light as the present types of air-cooled gasoline engines, but in view of the high degree of refinement of gasoline airplane engines, it is hardly likely that the Diesel will ever entirely replace them. However, it will assume a position of ever-increasing importance in those services where long range reliability, weight-carrying capacity, mechanical simplicity, and super-safety are desired.



Air Ministry Official Photograph, Crown Copyright

ONE OF THE BEARDMORE DIESELS USED IN THE BRITISH *R-101*

Sea-Safety Contest Winners

Our Competition Has Focused Attention on Devices That Make for Safe Navigation, and Are Reliable in Emergencies

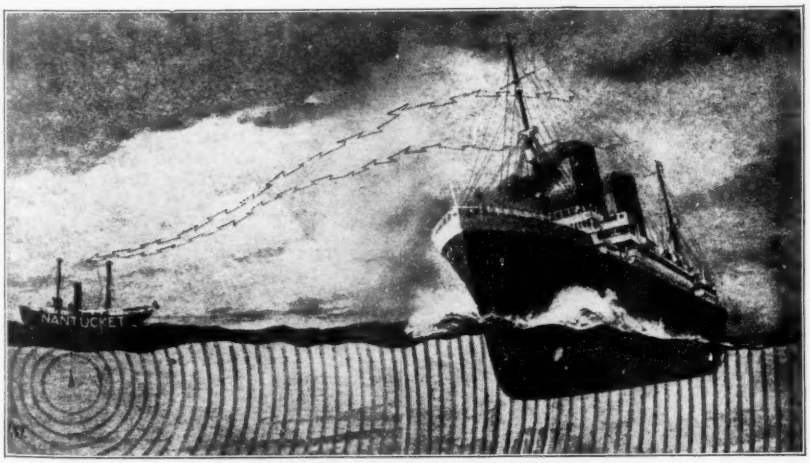
By ALBERT A. HOPKINS
Secretary of the Committee of Award

THE ninth SCIENTIFIC AMERICAN Gold Medal awarded by the American Museum of Safety was presented at a luncheon given by Mr. Arthur Williams, President of the Museum, at the Union League Club, New York, on November 7th. In the absence of Professor Fessenden in Bermuda, on account of severe illness, his son, Mr. R. K. Fessenden, received the medal and the citation signed by the members of the Committee, and responded for the winner. Mr. H. J. Fay, a business associate, read an admirable account of three inventions on which the citation was largely made. Those receiving the engrossed Certificates of Honorable Mention responded as each received the framed certificate.

THE task of the Committee of Award was to analyze the 80 designs or ideas: first to see if they conformed to the conditions; and second properly to evaluate their merit. The Committee was of highly technical structure, largely composed of men who are used to commanding vessels or fleets, and their decision may be regarded as of great technical value. Out of the 80 designs, 13 were selected for intensive examination; these were narrowed down to five, and then to one.

The Committee finally decided unanimously that the achievements of Professor Reginald A. Fessenden were sufficiently outstanding to warrant giving him the medal for his various devices for safety at sea. The award was made not for any one of his inventions but rather for a composite of them. Quite a formidable list of inventions was submitted and he then modestly narrowed it down to 12, as follows: The fathometer, acoustic-radio distance finder, phase compensator, iceberg detector, wireless direction finder (using the loop antenna), wireless compass (rotating and beam), gyrocompass and improvements, Fessenden prism, interference beam of radiation, submarine oscillator, wireless telephone, heterodyne.

Professor Fessenden joined the Submarine Signal Company in the year 1912, and at once his great inventive genius was directed toward the development of better means of transmitting sound signals for communication



FESSENDEN DISTANCE FINDER

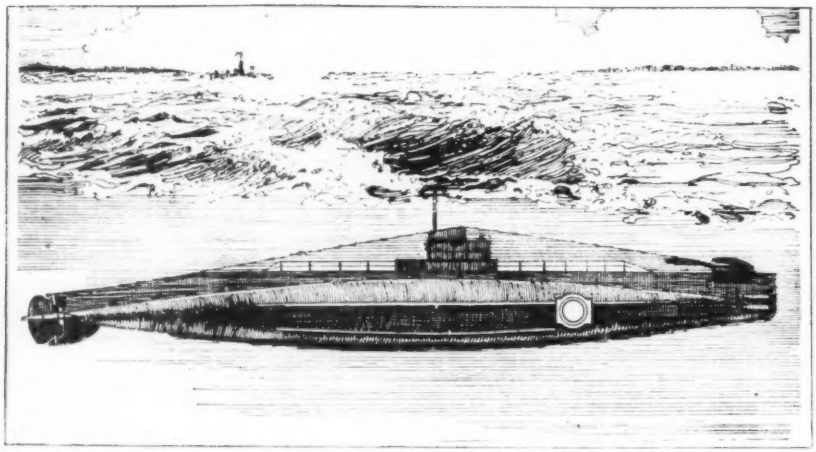
Radio signals and submarine signals sent out simultaneously from lightship. Time interval between reception of radio signals and submarine signals on liner indicates the distance

FESSENDEN FATHOMETER

The fathometer is an electrical echo depth-sounding device which enables vessels to avoid stranding by ascertaining the depth between keel of the vessel and sea bottom without stopping the ship

through the water, with results that have been of great benefit to humanity.

The perfection of the oscillator the following year revolutionized the art of submarine signaling, doubling and trebling the range at which it had been possible to send sound signals through the water. The ease and speed at which sound signals in the form of dots and



FESSENDEN OSCILLATOR

The oscillator sends dots and dashes through the water with ease and speed, doubling and trebling the range. Nearly every submarine in the world is equipped with this instrument illustrated at right

dashes could be sent through the water with the oscillator marked a tremendous advance over the older slow method of submarine signaling by a series of dots with a bell. The Navy, quick to recognize the value of the oscillator, adopted it for use on battleships and submarines. Today, practically every submarine in the world is equipped with one of these instruments.

Echo depth sounding, as embodied in the fathometer, marks the next and greatest work. This new method of depth sounding is linked in its history with the *Titanic* disaster. It was this appalling tragedy which led to experimenting with the submarine oscillator for the purpose of detecting the presence and proximity of icebergs, by means of an echo.

IN the winter of 1914, Professor Fessenden made tests on the Revenue Cutter *Miami*, while the latter was on its ice patrol off the Grand Banks. In these tests it was found that the oscillator could be used not only to detect the presence of and the nearness of icebergs but also to determine the depth of water beneath the revenue cutter by measuring the time between the emission of an oscillator signal and its return as an echo.

The submarine fathometer sends sound impulses periodically to the bottom of the sea, where they are reflected upward and then excite an electric sound receiver. The latter, by means of an electrical mechanism and a beam of light, indicates continuously on the calibrated dial the depth of water beneath the vessel.

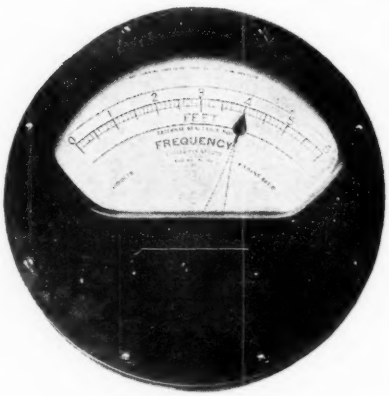
Because of the World War, work on the fathometer was delayed on account of activities in the development of submarine detection devices for the protection of shipping from the ravages of submarine warfare. After the war, the echo depth-sounding work was again taken up actively and the development of the fathometer was completed. In 1924 the first visual echo depth-sounding fathometer equipment was placed in practical operation on the steamship *Berkshire* and demonstrated to the Navy, to the Coast and Geodetic Survey, and to the Shipping Board. Following this installation came the approval of both the Navy and the Coast and Geodetic Survey of its accuracy and reliability.

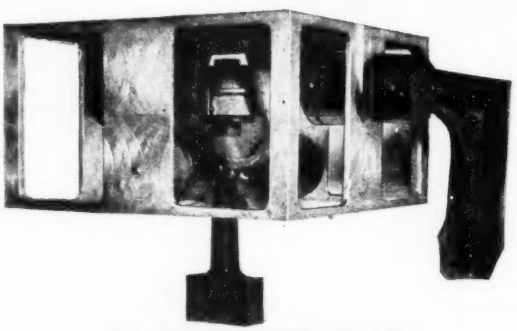
That the fathometer is destined to save countless lives, hundreds of ships and millions of dollars seems unquestionable. The recent Safety of Life at Sea Conference at London has recognized this in recommending that the contracting governments should encourage the development and use of echo depth-sounding apparatus.

After the award of the SCIENTIFIC AMERICAN Medal the Committee considered that three devices were so outstanding in merit that a "Certificate of Honorable Mention" should be given. These honors are given to three individuals, two in New York and one in Utrecht, Holland, without designation of relative merit. Mr. J. Lyell Wilson of the American Bureau of Shipping, Member of the Society of Naval Architects and Marine Engineers, and the American Institute of Electrical Engineers, was given an "Honorable Mention" for his stability meter.

THE stability meter was designed to provide a ready means for determining the amount of stability or metacentric height that the vessel has while at sea on a voyage, so that water ballast may be used when needed to correct an insufficiently stable condition by lowering the ship's center of gravity. This use of water ballast has always been available but the means for determining when to use it has not, except by prior estimates of inaccurate and sometimes doubtful value, because of the infinite variety of possible service conditions.

In order to measure the stability of a floating vessel it is necessary to have some fixed axis for reference to which known forces and their effects on the ship may be referred. This part of the solution, which requires elaborate preparation, calm water, and the absence of wind and all other extraneous forces, is merely to locate the ship's center of gravity when she is empty. In principle it is exactly like finding the center of any irregular figure by suspending





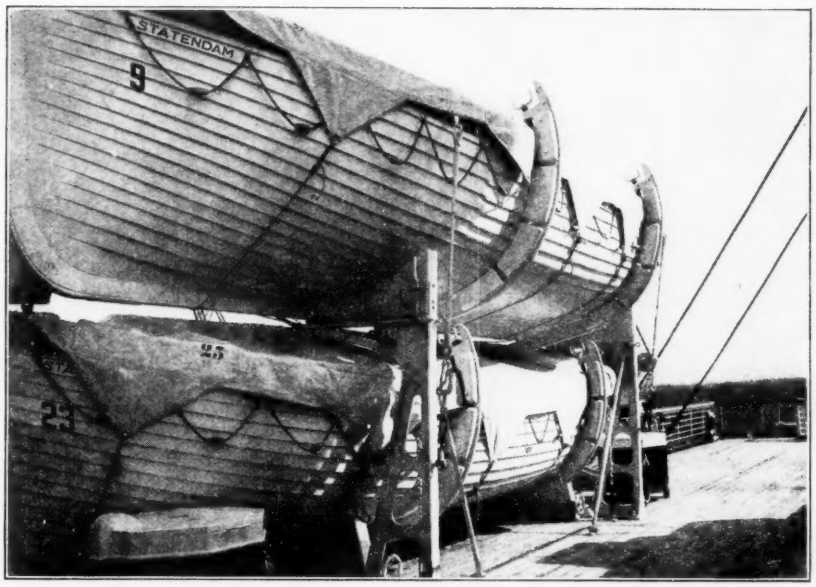
WILSON STABILITY METER

An accurate means for determining the amount of stability a vessel has while at sea, so that she can be ballasted. It utilizes a gyroscope and a pendulum

it from various points together with a plumb bob so that the intersection of all the traces of the plumb line will be the center of area or gravity. From such a procedure, called the inclining experiment, and with mathematical analyses based on the vessel's form and loading arrangements, her stability for various conditions may be analyzed.

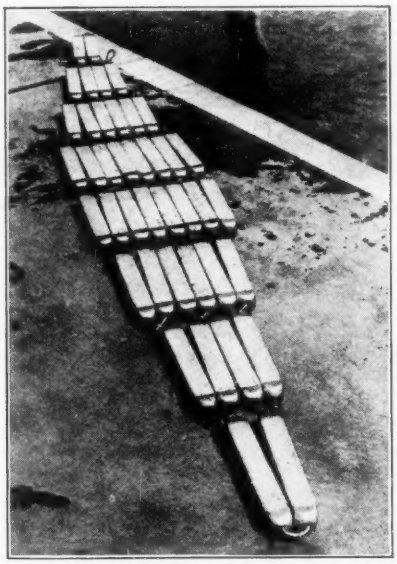
A much more accurate and convenient method of determining stability is available, however, in the use of the stability meter which ignores the statical condition in calm water but measures the dynamics during rolling, the reference axis being that of a gyroscope which is independently referred to a fixed axis in space.

The stability meter therefore comprises a gyroscope and a pendulum, each properly suspended in a frame fixed in the ship and actuating variable inductances, the component values of which are electrically integrated to give a resultant reading of metacentric height by means of a pointer traversing a dial similar to an ordinary voltmeter. Thus the action electrically is similar to the tuning of a radio set having two dials except that a variable voltage is produced instead of a variable frequency.



SCHAT SEA SKATE

A demountable attachment for life boats which facilitates their launching even with a forty-six-degree list. In launching, it skids the life boat over obstructions



Another "Honorable Mention" went to Mr. A. P. Schat of Utrecht, Holland, who made an unusual effort to secure the medal, even going so far as to make his presentment in the form of large beautifully illustrated pamphlets in the English language. Mr. Schat's device is called a "sea skate" and is an attachment to a life boat which enables it to be launched even with a 46-degree list. The "skate" skids the life boat over plates, bulges, and blisters, and once the water is reached it can be unfastened and sunk.

Mr. Jesse W. Reno of New York, a consulting engineer, received a "Certificate of Honorable Mention" for his life raft or live-saving net. His device consists of an extremely light raft or net made of balsa wood, the individual floats of which are joined by flexible connections, so that the net may easily be folded into a compact space for storage aboard the ship. When people are in the net in a rough sea, the lightness of the floats prevents injury when they are thrown against them by the sea, and the flexibility of the connections permits the floats to yield so that injury is prevented. Our illustrations give an idea of the device which is cheap, takes up little room, and has much to commend it in place of the ordinary life raft and the life preserver. Mr. Reno has devised a process for waterproofing the balsa wood so that its buoyancy is not impaired by becoming waterlogged.

The competition has served a useful purpose in focusing attention on these eminently practical inventions which are in being and which can be applied on any ship.

RENO LIFE RAFT OR NET

This life raft or net is made of water-proofed balsa wood. The floats are flexibly connected, giving freedom from injury. The device takes up little room and is very light

The Rarest Metal Yet Obtained

A Scientific Account of Research on Protactinium, Element 91, Which Is as Radioactive as Radium

By ARISTID V. GROSSE, Dr.Eng. (Chem.)
Director of the Chemical Research Institute, Shanghai, China

PROTACTINIUM, recently isolated by the writer, is a new, strongly radioactive chemical element. It is a metal like radium, but about two times rarer than the latter and, in fact, the rarest metal yet obtained in the world.

Of the great number of radio-active elements found since the splendid discovery of radium and radioactivity by Madame Curie in 1898, protactinium is the only one besides radium which can be obtained in larger amounts. Whereas the other radioactive elements are so extremely rare that most of them can not be seen even under a microscope, protactinium can be obtained in sufficient quantities to be investigated by the chemist in the same way as the common elements.

THE protactinium atom explodes in the same manner and practically just as violently as radium. While the average life of the radium atom is 2500 years, protactinium lasts about twenty times longer; that is, about 50,000 years.

During the explosion of the protactinium atom the alpha particles (helium atoms), electrons and gamma rays are shot off at enormous speeds. An atom of the element actinium is thus formed and it is from this property that protactinium derives its name (*proto*, meaning in Greek "first"). In addition to actinium a whole series of atomic disintegration products is formed, among which is the gas actinium emanation.

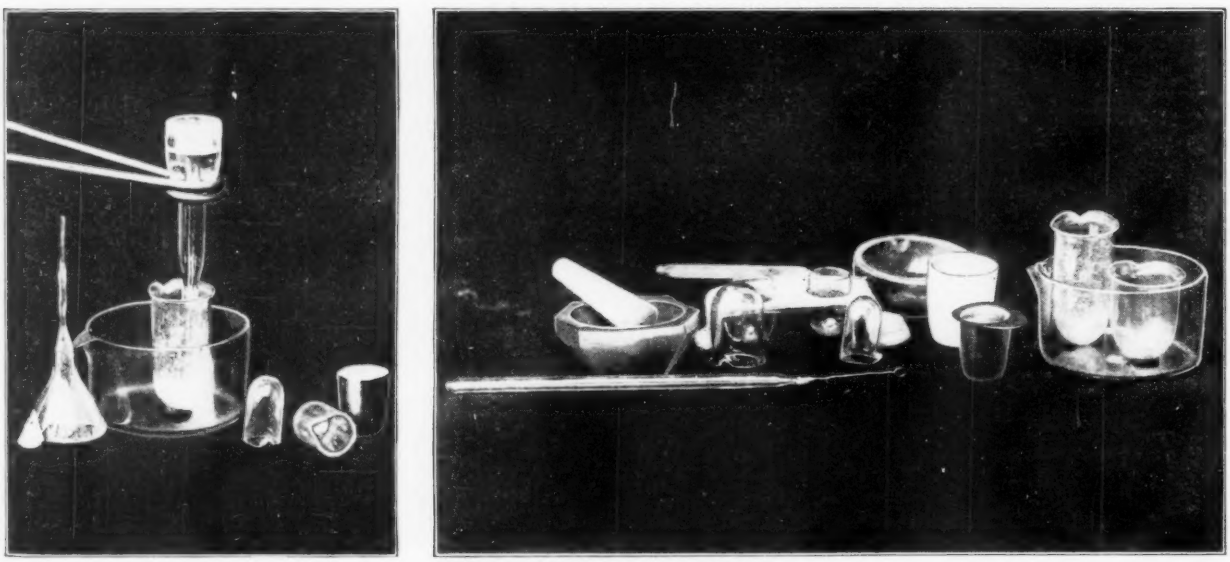
Chemically, protactinium is Element 91, called also "ekatantalum," occupying the ninety-first place in the periodic chart of the elements, between the two heaviest metals known, thorium and uranium.

FROM the text of the accompanying article, which was sent the editor from Shanghai, it is difficult to judge whether the author intends to claim the isolation of the pure element protactinium, as stated in the opening paragraph, or of the oxide as mentioned later. Apparently he refers to the latter. In any case his scientific feat is noteworthy. One American authority to whom the article was sent states his opinion that if protactinium comes on the market as a substitute for radium he does not believe the market price will reflect the fact that it can be produced more cheaply than radium but rather the fact that it is rarer. That is, the price would probably be higher than that of radium. This, of course, is put forth as nothing more than an opinion. —*The Editor*

The existence of Element 91 was foretold 60 years ago by the famous Russian scientist D. I. Mendeléeff, when he devised the periodic table of the elements. It was established as a fact in 1917 when Prof. O. Hahn and Prof. L. Meitner in Germany, and simultaneously Frederick Soddy, the distinguished pioneer of radioactivity working in England in collaboration with J. A. Cranston, discovered new alpha rays and proved that they came from a new element which could only be the Element 91, present in great dilution in their material.

DURING the following 10 years all efforts to obtain and isolate the extremely rare protactinium were unsuccessful, owing to the wrong chemical properties being attributed to it, and until 1927 nobody actually saw it. It was generally thought that Element 91 resembled tantalum, just as radium resembles barium; since the latter are always associated, an attempt was made to isolate protactinium by adding tantalum to the raw material and extracting them together.

In November 1926 the writer proposed a new theory of the chemical properties of Element 91, pointing out its difference from tantalum. In the spring of 1927 he had the good fortune of obtaining and seeing for the first time protactinium in the form of its



THE LABORATORY EQUIPMENT

At the left is the filtering apparatus and at the right the crystallizing equipment. As reproduced here each piece is seven eighths actual size, the "doll-house" sizes resulting from the minute, almost microscopic, quantities of materials involved in the work of research

pure white oxide, as shown in the illustration. The oxide forms an absolutely white powder with a very high melting point. It shines with a faint glow in the dark, due to the explosions in the atoms.

The difference from tantalum, previously predicted, was therefore established as a fact. It was not even necessary to try the separation of protactinium from tantalum, as it occurred by itself.

In 1927 only two milligrams of protactinium were obtained—just about as much as a needle point. As it was necessary to experiment for weeks with the same scarcely visible material, special equipment was devised to analyze, determine the radioactivity, filter, and crystallize minute quantities of matter. In the photographs, as reproduced, the original apparatus used is shown seven eighths natural size.

Very great care had to be taken during the work in order not to lose the extremely valuable material. Once one of the tiny beakers containing the whole available amount of protactinium slipped out of the writer's fingers and only by a lucky chance was an irreparable loss avoided. The experiments were accomplished during the author's stay in Germany, at the splendidly equipped Kaiser Wilhelm Institute of Chemistry, in Berlin.

IN nature protactinium always accompanies radium in uranium minerals and ores. These contain for each gram of radium about 0.6 grams of protactinium. As has already been pointed out, Element 91 is the rarest metal obtained in the world, leaving far behind such rare elements as rhenium, discovered in 1925 by W. and I. Noddack and O. Berg in Germany, and illinium, discovered in 1926 by B. S. Hopkins, L. F. Yntema, and J. A. Harris of the University of Illinois.

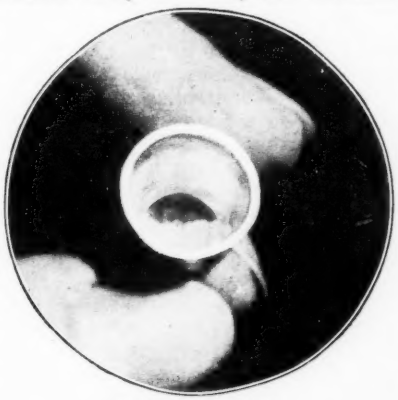
In the richest uranium minerals Element 91 is found in the fantastic proportion of only 1 part to 10,000,000 parts of ore. It is therefore necessary to work up tons of raw material to get only grams of the new element. A special procedure is employed to detect the presence of Element 91; it is now possible to determine the amount of protactinium with great accuracy even in a dilution of 1 to 2,000,000,000, thanks to special analytical methods worked out at the Shanghai Institute.

COMPARISON of the PHYSICAL PROPERTIES of PROTACTINIUM and RADIUM.

Properties.	Protactinium.	Radium.
Alpha rays:		
Range in centimeters at 15°C.	3.673	3.389
Velocity in kilometers per second.	15,500	15,100
Energy in volts.	2,540,000	2,365,000
Beta rays:		
Maximum energy in volts	318,200	185,000
Gamma rays:		
Wave length of the most penetrating ray in 10^{-11} cm.	38.2	66.0
Maximum energy in volts.	323,000	187,000
Average life of atom in years.	46,000	2,500
Price per gram in dollars.	? ?	65,000

HOW PROTACTINIUM DIFFERS FROM RADIUM

The use of the word "rays," although common, often misleads the layman. Alpha and beta rays are really particles rather than waves such as the gamma rays are. The latter differ from visible light only in wavelength and occur in the ether of space, like radio waves



FIRST RESULTS

Tiny crucible with first protactinium ever obtained. Note white oxide powder

While the uranium ore is worked up for radium, the Element 91 accumulates in the insoluble residues which constitute the wastes from radium factories and which previously had no commercial value. These waste residues contain protactinium in a much greater proportion than the natural uranium material, and therefore they represent at present the best raw material for the production of the new element.

One gram of radium now costs 65,000 dollars and, since Element 91 is rarer, one would think that its production cost would be higher. Yet protactinium would not be nearly so expensive as radium because the radium wastes are cheap, because their protactinium content is higher than that of radium in uranium ore, and because the protactinium extraction process is fairly simple.

For further research on protactinium larger quantities than the two milligrams obtained in 1927 were needed, and in 1928 radium wastes could be worked up in an industrial scale, thanks to the great German "dye trust" (*I. G. Farbenindustrie A. G.*). From half a ton of wastes from the old radium factory in Joachimsthal, Bohemia, which was presented by the government of Czechoslovakia, about 40 milligrams, or one hundredth of an ounce, of protactinium were extracted, under the supervision of the writer, at one of the *I. G. Farbenindustrie's* factories at Ludwigshafen on the Rhine.

THE protactinium extraction process is fairly simple—much simpler than the production of radium. This is due to the individual chemical properties of Element 91, which differ very much from any known element. Radium, on the other hand, greatly resembles barium, so that it is difficult to separate the one from the other.

The wastes from radium factories

PERIODIC TABLE OF THE ELEMENTS
(lower right hand corner)
showing the position of the new element .

Symbol & atomic No.	Hf 72	Ta 73	W 74	Re 75	Sixth
Atomic weight.	178,6	181,5	184,0	188,7	period.
Symbol & atomic No.	Th 90	or Et Pa 91	U 92		Last
Atomic weight.	232,1	?	238,1		period.

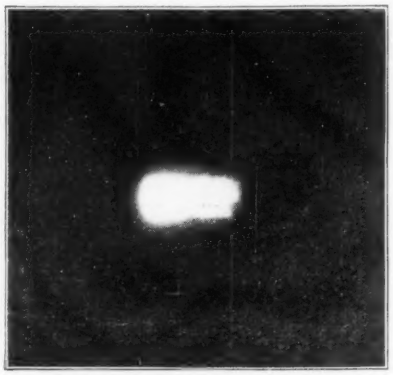
HOW ELEMENT 91 FITS INTO THE PERIODIC TABLE

All of the (presumptive) 92 chemical elements have now been discovered except two, Numbers 85 and 87. Chemists in various laboratories are engaged in more or less persistent efforts to isolate these two and it is unlikely they will be able to "hide out" much longer

contain large amounts of silica and iron oxides. They are first boiled with concentrated acids, which dissolve all the iron and other soluble oxides, leaving the "silica residue," which contains Element 91. This residue is melted with alkalies and the melt is extracted with water. This dissolves all the silica and leaves a small precipitate, containing the Element 91 in the concentration of 1 to 10,000. The latter is dissolved in dilute acids and from this solution protactinium is separated, together with the metal zirconium, as a phosphate. By a special method, called by the author the "spiral process," Element 91 is separated from zirconium and freed from all other impurities.

The United States and Belgium are the only two countries in the world which can supply the raw material for protactinium production on a large scale. In the wastes of American radium factories which work up the uranium ores from Utah and Colorado, more than 100 grams (.22 pound) of protactinium are stored, an enormous quantity when we consider that the world radium production since the discovery of that element does not amount to more than 350 grams (three quarters of a pound). Belgium produces radium from rich uranium ore imported from her colonies in Africa. The amount of protactiniferous wastes is much smaller than in the United States, but probably of a better quality.

PROTACTINIUM is thus a very new scientific baby—and nobody knows what use it will find in the future. Nothing has been done as yet to find an industrial and commercial application for it. Evidently much larger quantities than the small amount which constitutes the whole present world production of this element are needed to start experiments. However it is not likely that protactinium will replace radium, for the latter produces in a shorter time a larger amount of effective radioactive disintegration products than protactinium.



PHOTOGRAPHIC EFFECT

Five milligrams of protactinium in a small box placed for a few minutes on a plate wrapped in light-proof paper

In medicine, Element 91 ought to find a different application than radium salts, as protactinium compounds behave quite differently in the body of living beings.

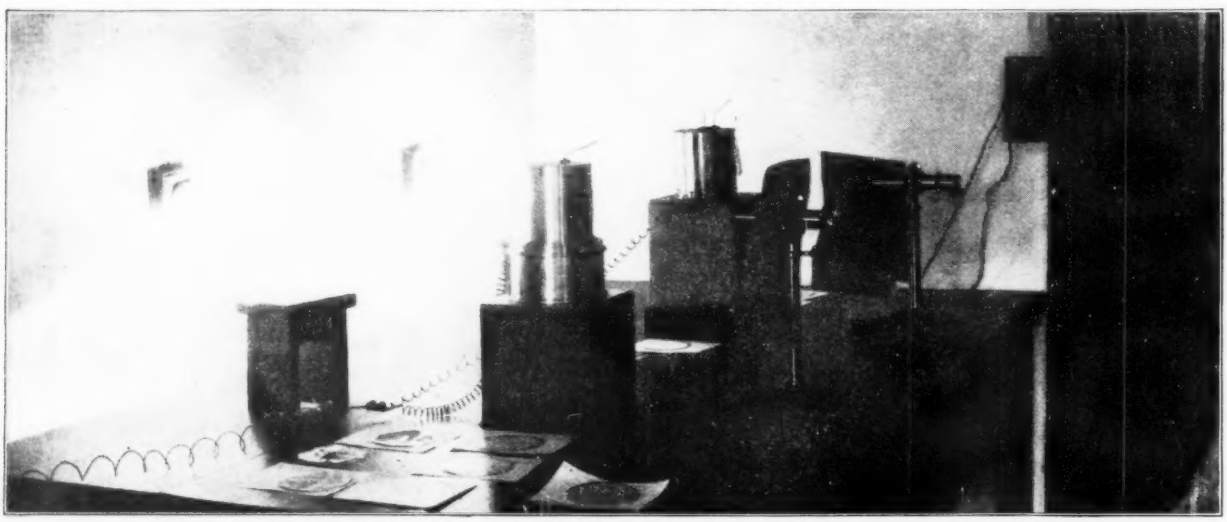
Protactinium is the only radioactive element that can be obtained as a metal. It can therefore be formed into sheet and wire and alloyed with other metals. Perhaps on account of this property protactinium will be of some value later on.

One definite advantage which may accrue from the research is the possibility of getting actinium. This element is 2000 times rarer than Element 91. It has therefore never been seen by human eyes, although it already has a practical application, in extremely diluted form, in radiotherapeutics, as it is over 100 times as active as radium. Actinium atoms are constantly being born from the mother substance, protactinium, and since the latter is now obtainable in a pure state it is extremely easy to separate the "baby," actinium, from protactinium and prepare it in visible quantities.

Large quantities of Element 91 are required for purely scientific research work. When they shall have been obtained it will be possible to answer many important questions about the chemistry and physics of this element. Then the so-called "actinium riddle" which has bothered scientists for 20 years and which Prof. A. S. Russell of Oxford, a leading British radiologist, recently termed "one of the outstanding problems of radioactivity," will be solved. It is the riddle of the origin of protactinium and the actinium which requires an explanation. Since the protactinium atom dies after having lived 50,000 years, and since our mother earth has existed for many millions of years, the birth of protactinium atoms must take place somewhere and from an unknown mother element of long life.

Certainly anything that will bring us a step further in the science of radioactivity is very important, since it is this science that has furnished a great deal of those fundamental facts on which our present day conception of matter, the atom and the way it is made, are based. From this point of view the scientific importance of Element 91 is probably greater than any commercial value it may acquire in the future.

The technical obstacles in the way of large-scale extraction from radium wastes have been overcome and it is hoped that the difficulties in organizing a production of larger amounts of protactinium will be solved as soon as possible, so that its many still unknown properties may be studied.



HIGH-PRECISION ELECTROSCOPES WHICH DETECT MINUTE AMOUNTS OF ELEMENT 91

These electroscopes will measure the amount of protactinium in extreme dilutions of one part in two billions. They are discharged at a measurable rate by the radiations from the element. The rate of discharge is read through small fixed telescopes at the right

Light Airplane Design Contest Winners

First Prize Awarded to an Army Flyer, Second to a Commercial Designer and Third to a Midshipman

THE Committee of Award in the SCIENTIFIC AMERICAN contest for the best design of an airplane to be built around the Cirrus engine, reports as follows:

"We have carefully examined the designs submitted for the Light-Plane Contest on the following rating system:

General suitability of the plane for training and private use and excellency of the design	20 points
Performance	15 points
Power plant installation	15 points
Construction and ease of maintenance	80 points

and have allotted points to the candidates as follows:

Rigby No. 17	125
Huep No. 2	117
Beebe No. 7	100
Boyvey No. 1	91
Brogden No. 11	84
Chase No. 16	73
Sartain No. 4	73
Davidson No. 9	59
Surgeoner No. 19	59
Eames No. 3	56
Brown No. 12	38
Vining No. 14	36
Burnett No. 13	36
Galloway No. 5	27
Roman No. 8	3
Boer No. 10	3
Hamburger No. 15	3
Elset, Melve	Disqualified, Wrong Motor

"In the opinion of all three of us, Mr. Rigby's design was undoubtedly the best both from the point of view of original conception and presentation, and deserves the prize.

"Mr. Huep's design deserves honorable mention.

"It has given us great pleasure to co-operate with you on this, which has undoubtedly done much to further thought in the realm of Light-Plane design."

Sincerely yours
Amelia Earhart
George Palmer Putnam
Alexander Klemin

PRIVATE JAMES P. RIGBY, 65 Squadron, Luke Field, T. H., therefore receives the SCIENTIFIC AMERICAN Gold Aviation Medal and 500 dollars. F. R. Huep, 1613—9th Street, Des Moines, Iowa, receives a similar silver medal and Midshipman R. P. Beebe, United States Naval Academy, Annapolis, Maryland, receives the bronze medal. It is interesting to observe that all three branches of our flying activities are represented among the winners.

Because the winners are so widely scattered, it was impossible to make a personal presentation and the prizes were sent to each without further ceremony. In our February issue we will publish details of the winning design.

ALTHOUGH a cablegram was dispatched to Mr. Rigby in Hawaii immediately upon receiving the decision of the Committee, we have not, at the time of going to press, received a photograph of him, or the interesting details of his career such as we publish below for the second and third prize winners. Therefore, we will include these when we publish the details of the winning design.

F. R. HUEP, 28 years old, was born and received his technical education in Germany. He was a designer for the Heinkel and Albatross airplane factories, later becoming assistant to Dr. Lackmann, co-inventor of the slotted wing and other safety devices. In 1926 he came to the United States and designed the Hurd low-wing monoplane H. M. I., and is at present chief designer for the Bolte Aircraft Company of Des Moines, Iowa, for whom he has designed and built three types of low-wing planes. He is a member of the S. A. E.

MIDSHIPMAN R. P. BEEBE first became interested in airplanes in Manila where his father, Col. R. E. Beebe, was then stationed. He has passed through all stages from model building to flying solo. In his high school days he spent many hours in the Air Service Library at Washington studying design. A brother is in the same class at West Point.

Congratulations to the winner and appreciative thanks to the Committee who so helpfully and efficiently worked out the *modus operandi* and rendered their decision. Thanks are also due to Col. R. Potter Campbell for his generous support of aviation by providing the prizes in this contest.

How Well Does the Car Stand Up?

Grueling Tests on Proving Ground Show Capabilities and Characteristics of Cars

By H. F. OLMSTED

"ONE hundred and twelve miles an hour! What if a tire should blow out?" The speaker stood along the inside rim of one of the high banked turns of the Packard Motor Car Company's proving ground 2½-mile speedway and watched as Colonel Charles A. Lindbergh roared past every 80 seconds at the fastest speed he had ever made on the ground.

But "Lindy," who was driving the car as a lark, was as safe from any danger in case a tire had blown out as if in his own *Spirit of St. Louis*. One or all four tires on the Packard speedster which he was driving could have blown on either of the two big curves of the track and the car would have kept going without wavering from its course. The track is so built that when a car once enters one of the turns it will hold to its course without a hand on the steering wheel. It actually can be steered by the accelerator pedal.

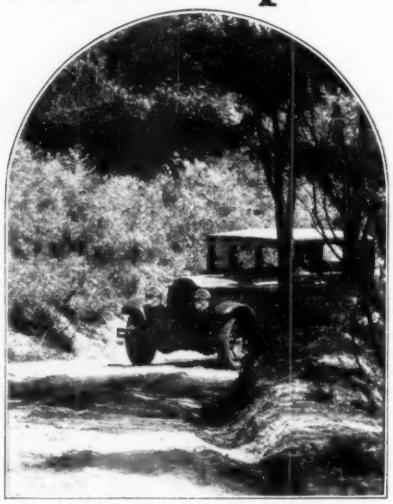
This is one of the many interesting features in the big 500-acre plant which is used for testing Packard cars. A crew of experts who the year 'round drive cars about the big concrete oval at top speed, bounce them over roads as rough as they can be and still have any claims to being roads, or put them through any of the many other tests with which the proving grounds abound, have found that blowing tires at 75 or 100 miles an hour is one of the least of the dangers confronting them at high speed.

Sleep probably would be numbered by any one of the drivers as the greatest menace to safety. Ring-neck pheasants would be the next. Collision with other cars would not enter at all nor would the blowing of tires. Sleep has caused the only accidents which have occurred on the track. Pheasants several times have threatened accidents.

Stamina of a motor car is tested by starting it out on the track at the fastest speed of which it is capable and holding the throttle wide open for many days and nights with stops only for gas, oil, water, or the changing of tires or drivers. Monotony grows with ceaseless circling of the track. Screaming of the wind made by the speed of the car, blending into the singing of the tires on the concrete, the drivers have found, is as effective a sleep producer as the croon of a southern mammy's lullaby.

A year ago the driver of a sedan under test went to sleep while travelling 80 miles an hour. He woke up as the car was leaving the track on its first bounce. It rolled over five times. The driver escaped without a scratch and the car was unharmed. It was an extra, impromptu, but most effective test of the stamina of the body construction. Since then precautions are taken constantly to guard against sleep.

THE proving grounds are located near the village of Utica, 20 miles north of the company's factories in Detroit. It is a section abundantly supplied with small game, most numerous of which are ring-neck pheasants. Several encounters have occurred between the pheasants and cars and each time the car has scored "dead bird."

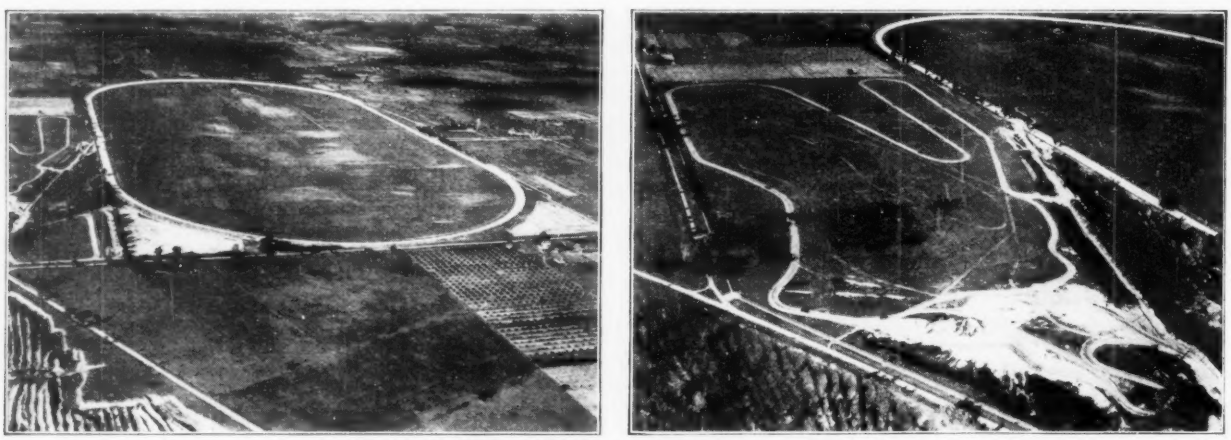


LIKE A COUNTRY ROAD

One of the test roads on the Packard Proving Ground, simulating an unpaved, rough byroad such as is often found

Pheasants are fast-flying birds and travel with the directness of an arrow. Several times they have been struck when shooting across the track. Each time the car was an enclosed model and the bird failed even to crack the non-shatterable glass of the windshield against which it struck. Drivers think of the pheasants as an actual menace while traveling at high speed in open cars with the windshields folded down. They also say it is humanly impossible not to "duck" the head down when a bird crashes into a windshield or window of an enclosed car, although knowing the glass can do no more than crack, without flying into pieces as would ordinary glass.

It is considered remarkable that accidents, even those of slight nature, are most infrequent, as the day's work of the testers consists of putting cars through the most severe kinds of

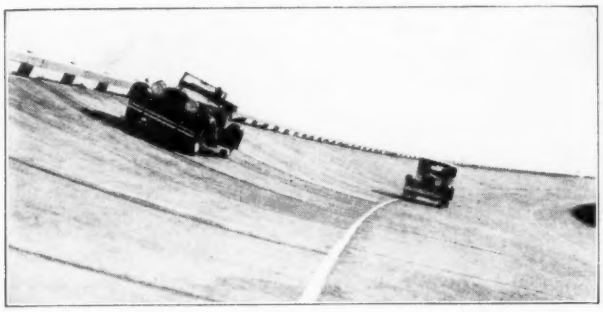


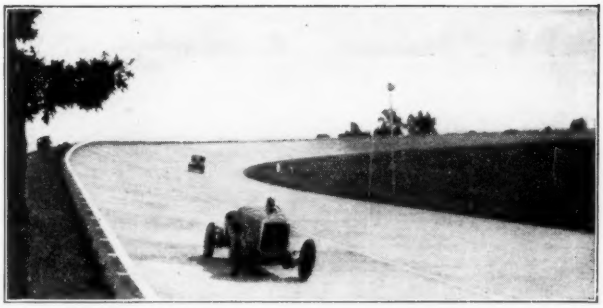
SPEED AND MANEUVERABILITY

At the left is shown the oval track on which speed tests are made. On the irregular track at the right, cars are run at high speed, around sharp curves, through sand traps, up difficult inclines, and over bumpy ground. Several cars may be seen on track

ON THE CURVE

The corners on the oval speedway are so curved transversely that a car, traveling at speed, will steer itself if a tire should blow out





ON THE STRAIGHT-AWAY

This track is so safe that the worst thing the drivers have to contend with is sleep due to the monotonous hour-by-hour grind

trials many times with the avowed purpose of trying to cause some part to break.

The proving grounds extend for a mile along one of the main highways leading from Detroit to Northern Michigan. In the whole establishment the company has combined a vast amount of beauty with the utility of the place. In a large lodge house set back some distance from the main highway in a profusion of trees and shrubbery are living quarters for the superintendent, offices, quarters for drivers and engineers, a large garage, and a complete short-wave radio broadcasting station.

ANOTHER building in the rear and across a paved court from the main lodge houses a complete installation of testing apparatus, including dynamometers and a machine shop. It also contains the boiler room which provides heat for all of the buildings, and houses machinery of the water pumping system, a plant large enough for a small city.

A double drive from the buildings to the track is flanked by a putting green and a four-hole "golf course."

The timing stand is at the end of the drive where also is located the main entrance to the track. A complete equipment for recording weather conditions is located in the timing stand where the electric timing device also is set up.

The testing track is an oval consisting of two parallel straight-aways each three quarters of a mile long, joined at each end by a half circle one half mile long. The inner circumference is two and a half miles. The curves at each end consist of three sections; the first has a slope of one degree for drainage, the second rises 11 degrees, and the third section 29 degrees. Driving around the curve, one has a strange optical illusion. The first section seems to slope sharply toward the rest of the track. Often during heavy rains water draining off the track seems actually to be running up hill.

On the center section, with the slope of 11 degrees and the large radius of curvature, any side thrust is canceled at 60 miles an hour, so that at this speed a car will steer itself. Higher speed carries a car up onto the third or high-speed section. Here there is no side thrust at 100 miles an hour and a car actually would steer itself at this speed.

So scientifically planned was the track that it has the record for the fastest time ever made on any circular speedway in the world. This was established by Leon Duray, well known race driver, when he made one lap with his special racing car at the rate of 148.17 miles an hour.

Inside the track is a 265-acre landing field, with mile-long runways, which is used by the company for testing planes equipped with the aircraft motors which it builds. It was from this field that the first airplane powered with a Diesel type engine was flown. A hangar at one end of the field houses the test planes.

One of the most serious construction problems encountered was presented by the landing field. It was a waste of sand, a miniature desert, and farmers of the district shook their heads when they learned that it was planned to develop the area into a lawn. Experts were called in. One hundred tons of fertilizer were used and 41,000 pounds of grass seed were planted while at the same time the whole field was sowed with oats which, it was believed, would take root quickly and hold the sand long enough for the grass seed to germinate and make a stand strong enough to hold the sand alone. The entire field is now covered with a thick sod.

BEYOND the testing track is the "rough ground" and the test roads. The roads—gravel, sand, and plain old-time country dirt—turn and twist all over the place and are so designed as to give the hardest kind of a test to all parts of the car, including the steering gear.

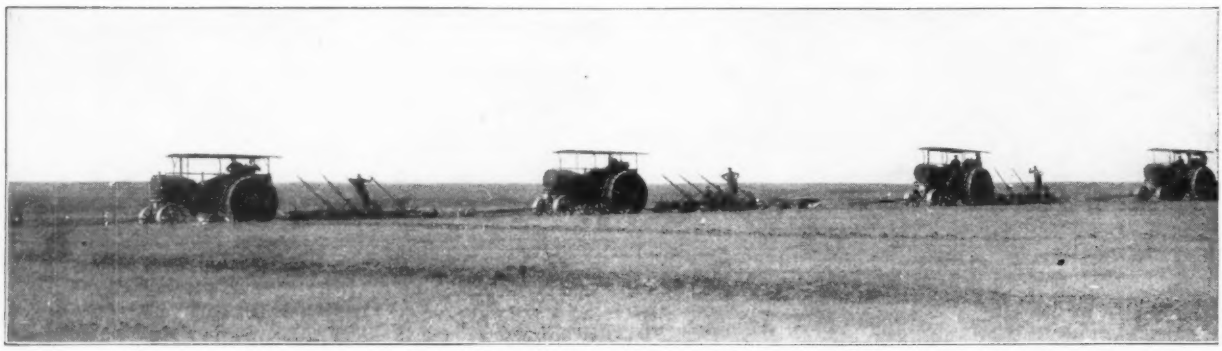
At one point along the test roads there are two artificial hills which, with other dips, give the effect of a roller coaster. Another much steeper hill has been built up so high that an excellent view from the top is obtained of the whole proving grounds and the surrounding country. A miniature desert is provided at another point. It is enveloped in a cloud of dust when cars are sent plowing through its deep sand during test work.

While hills are located along the test roads, enigmatical as it sounds, real hill climbing tests are conducted on the level stretches of the speedway. On the flat concrete, mountains of any grade and of any length are simulated perfectly by a device known as a towing dynamometer.

The towing dynamometer is a car which is towed behind the car under test. An air compressor takes the place of the motor to give the dynamometer car the most powerful braking effect. The frame is loaded with hundreds of pounds of lead to give the wheels greater traction. The towing bar has a piston at one end which works in a hydraulic cylinder. Pressure in this cylinder is registered on gages on the dash so that there is a constant record of the draw-bar pull.

Compression in the air compressor can be regulated through relief valves at the will of the observer in the driver's seat of the towing dynamometer. If a heavy grade is desired the relief valves are set to the proper point. They are so calibrated that any percentage of grade can be maintained.

THE big Packard proving grounds well illustrate to what extent some companies in the automotive industry go in constantly striving to better the quality of their product. It is the largest plant created for proving and improving just one kind of car and represents an investment of well over 1,000,000 dollars. Only a few years ago proving grounds were unnecessary for all motor cars, as engineers had no difficulty in finding many ways of making improvements. Motor cars of better quality, however, have now reached a state of refinement where the most enhaustive tests are necessary to discover means of betterment and to make certain that the quality of the car is being constantly maintained.



ESTABLISHING A WORLD'S RECORD BY PLOWING, DISKING, SEEDING, AND

Mass Production

Large-Scale Farming Operations May Be Revolutionized

By HENRY

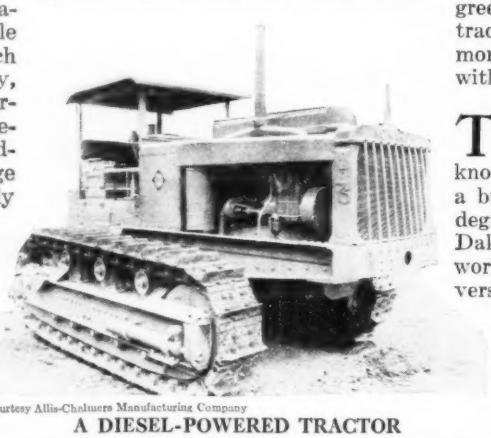
WHEELS—big wheels and little wheels—with ample power to keep them turning day and night until the last of the fleet of tractor-drawn combines has threshed its last bushel of grain—that is the story of harvest-time at the 95,000-acre farm of the Campbell Farming Corporation, which occupies part of the Crow Indian Reservation in Montana. Agriculture a-la-Detroit is the *pièce de résistance* on this tremendous farm, where the production of nearly a million bushels of wheat a year is accomplished by means of the most advanced farm machinery, mass-production methods of operation, and an up-to-date system of cost accounting.

Power is obviously a factor of paramount importance in such large-scale farming operations, where as much as 1000 acres can be plowed in a day, and 2000 acres can be seeded or harvested. One is not surprised, therefore, that the attention of the world-famous agricultural engineer in charge of these operations has been lately focused on the most economical power source yet perfected—the Diesel oil-engine.

SEVERAL tractor manufacturing concerns have been experimenting with Diesel engines, and recent experiments and field tests in a 400-acre field on the Campbell farm indicate that the gasoline-driven tractor is perhaps soon to become as obsolete as its steam-driven forerunner.

The tests were revolutionary, according to Mr. Thomas D. Campbell, President of the Campbell Farming Corporation. "With an Allis-Chalmers Monarch tractor powered with a Diesel engine operating on furnace oil, plowing costs were cut to about one seventh the usual figure. Pulling 10 plows at a depth of about 10 inches the tractor plowed the 400-acre tract at a rate of 36 acres per ten hours of operation. With more efficient operating methods, I am confident that the Diesel engine will enable us to reduce our expense for heavy plowing to about one tenth the usual cost when operating tractors powered with gasoline engines.

"Of course the Diesel engine is somewhat heavier than other types of internal combustion engines. However, in a tractor this factor is an asset rather than a liability, particularly when operating with a heavy drag. I believe that the next ten years will be an era of Diesel-driven tractors. This development is of outstanding importance, for more power is required to plow the farm lands of the United States, in the time they should be plowed, than is needed to operate all other industries together, including our great transportation systems."



Courtesy Allis-Chalmers Manufacturing Company

A DIESEL-POWERED TRACTOR

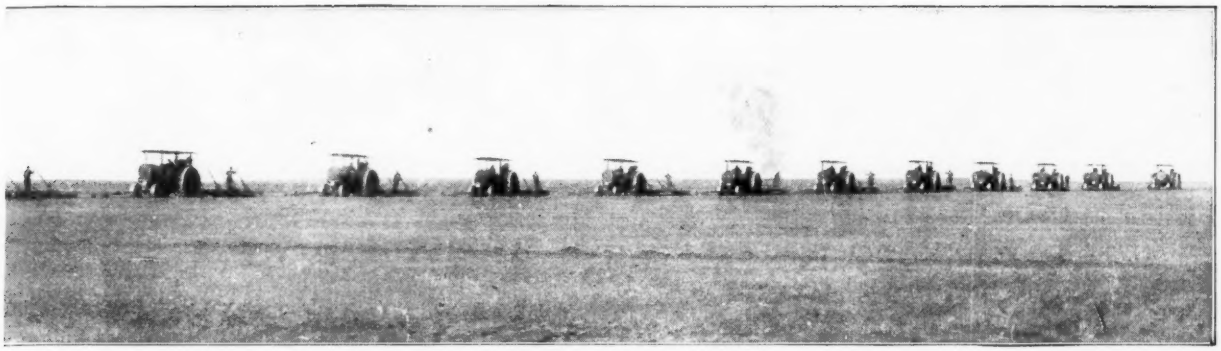
Tests on the Campbell farm with this tractor powered with a Diesel engine inaugurated a new era in power farming operations of the type practiced in the west

Agricultural engineers have observed and analyzed Mr. Campbell's operating and production methods, and have studied his simple but highly successful system of cost accounting. Farmers, economists, and the general public have listened to his enthusiastic description of the Campbell brand of farming, seeing in the far-flung operations of the corporation a more scientific scheme for feeding the world. Manufacturers of farm machinery seem to regard the Campbell farm as a proving ground for various types of new equipment designed to increase production of agricultural products on a more economical basis.

A "farm hand" would be as much of a novelty as a horse or a cow on this farm; the workers are mechanics, who are paid mechanics' wages, or work on a basis of mileage covered with an attractive cash bonus at the end of the season. High wages, comfortable living quarters, and a relatively large degree of individual responsibility attract skilled workers of an uncommonly high type, many of them men with technical training.

TOM CAMPBELL, as the head of the corporation is generally known, is an engineer, a farmer, and a business man. After receiving two degrees at the University of North Dakota, and taking post-graduate work in engineering at Cornell University, he took over the management of the family farm in the Red River Valley in North Dakota. A few years later he was engaged in various large-scale agricultural development projects in California. When the war-torn nations of Europe turned to the United States for emergency supplies of wheat, Mr. Campbell secured the financial backing of a group of internationally prominent bankers and began to raise wheat on an unprecedented scale, making use of large areas of unproductive government land.

"Dry farming" on the semi-arid plains of the west has broken the spirit of thousands of homesteaders farming relatively small tracts with unscientific methods and inadequate



PACKING 640 ACRES IN ONE DAY, WITHOUT A HALT FOR MECHANICAL TROUBLE

In Agriculture

By Means of Tractors Powered With Diesel Engines

W. HOUGH

equipment. To raise a paying crop on barren prairies with only about 15 inches of rainfall a year and temperature variations from 40 degrees below zero to more than 100 degrees above, is an undertaking that requires sound knowledge, skillful management, and a reasonable amount of luck. About the time Mr. Campbell was launching his project in southeastern Montana, agriculture in that region went through the worst period in its history; parching drought destroyed one crop, myriads of grasshoppers consumed another, and the first good crop was made valueless by the utter collapse of the wheat maket.

THOUSANDS of farms were abandoned, but Mr. Campbell secured new capital and carried forward his carefully made plans. Planting only half the usual amount of seed to the acre, in order that whatever moisture might be available would be used to best advantage, he raised a good crop and marketed it at a substantial profit. Since then his operations have been successful every year, and as the total acreage in crop increases, production costs go down. When he wishes to increase his output, Mr. Campbell pays his men higher wages and the average production per man increases to a new high level.

The total acreage of the Campbell properties is sub-divided into units of from 5000 to 32,000 acres. With 640 acres to one square mile, it will be seen that the Campbell farm occupies about 150 square miles. To take an inventory of the equipment would seem to be a good job for an aerial photographer; when listed, the more important types of machinery represented would include 56 tractors, 72 binders, 21 combines, 11 threshing machines, 500 plows, 60 12-foot drills, 200 wagons, 20 motor trucks, and 10 automobiles. Gasoline is received from Montana or Wyoming refineries in tank cars consigned to the Campbell Farming Corporation at Hardin. There is gasoline storage capacity on the farm for approximately 70,000 gallons.

Maintenance is an item of great importance, for few man-made machines can withstand the punishment imposed by almost uninterrupted operation over rough ground at a speed of three miles an hour, often working both day and night. Every piece of new equipment is reinforced before it goes to the field. At the company headquarters in Hardin, the farming corporation maintains a large repair shop, which saves about 2000 dollars a month on maintenance costs, according to Mr. Campbell. It includes a forge shop, machine shop, brass foundry, and complete equipment for welding. The 200 skilled men who operate the tractors, combines, and other machinery, are able to make most mechanical repairs in the field. The busy season is from the first of September to the first of December. When this period closes, all of the equipment is overhauled completely and put in shape for the coming season. A crew of about 50 selected men attend to the necessary work during the winter months when most of the crop is in the ground.

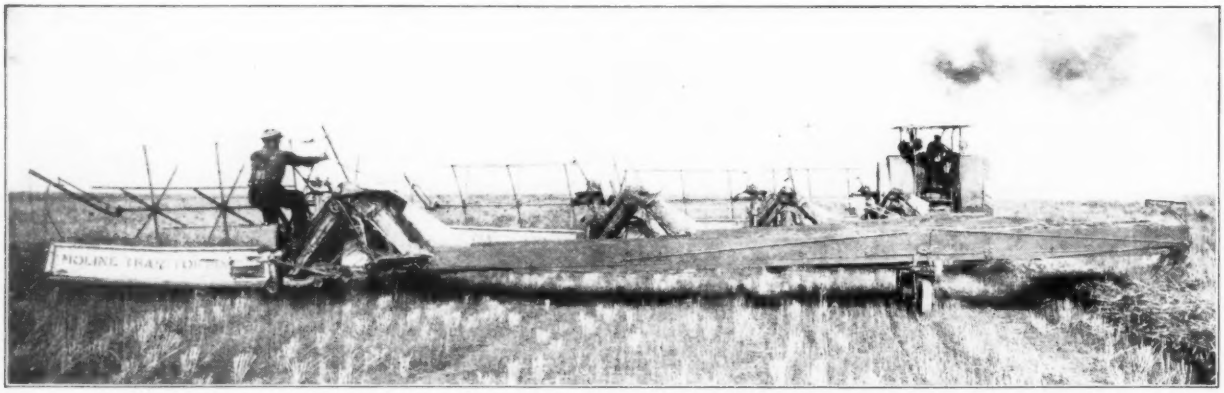
Winter wheat is the principal product of the Campbell farm, although large areas are also used for raising spring wheat and flax. Growing conditions in eastern Montana are particularly favorable for raising these crops, but producing spring wheat is relatively hazardous because of the hot, dry winds of the summer which are likely to wither and shrivel grain planted in the spring.

PREPARING the ground for the seed is the most important part of farming operations on the semi-arid prairies. The scant rainfall and snow do not provide sufficient moisture for maturing the crop unless the moisture of the previous season has been well stored in the soil. Summer fallow one season in three gives the soil an opportunity to replenish its supply of growth-giving constituents and moisture. After the harvest, the land is disked to enable the fall rain and winter snow to soak deep into the soil. Early in the spring the fields are disked again, and then left fallow until May. By that time there is considerable growth of weeds and volunteer wheat, which is plowed under for fertilizer, usually with a light duckfoot plow. The soil is pulverized with a spike-tooth harrow later in the summer, and seeding begins early, usually about the middle of September, in order to give the grain time to get sufficiently well established so that it will withstand the rigors of winter.

For the first crop the ground is

THIS LITTLE WAGON TRAIN GOES TO MARKET

Long trains of grain wagons drawn by tractors are supplemented by fast grain trucks hauling two or three trailers, in harvest season. Trains rush the crop to the markets



HARVESTING GRAIN BY THE "WINDROW" METHOD DEVELOPED BY THOMAS D. CAMPBELL

After the wheat or flax is cut and piled loosely in long rows to cure, a tractor-drawn "combine" picks up the grain and threshes it. This method makes the use of the combine practical in almost any agricultural region on relatively small farms as well as large ones.

plowed and disked, but the following year it is simply double-disked, turning under the stubble and the straw scattered by the combines. Plowing costs have been reduced to about two dollars an acre, but disking can be done for less than one fourth that amount. In 1924 the Campbell farm established a world's record by plowing, disking, seeding, and packing 640 acres in one day of 16 hours. Fifteen tractor-drawn assemblies were kept in operation without a halt for mechanical trouble of any kind; the tractors were refueled without making a stop. Now the rate of a section a day can be continued as long as is necessary properly to plant the crop, and 1000 acres a day can be put in when desired.

Profiting by his experience the year of the severe drought, Mr. Campbell uses only about 20 pounds of seed to the acre, or about half the amount of his first seedings. For the second crop only 10 pounds of seed to the acre is used. The usual yield is about 15 bushels to the acre, although in 1924 the yield averaged 30 bushels.

Another world's record was established in 1924. Threshing, now done in most of the important wheat-producing regions with tractor-drawn combines, was then done with stationary threshing machines powered from nearby tractors. With one standard Case threshing machine outfit, 4321 bushels of wheat were threshed in one day of 14 hours. The record is one that will probably stand for all time, because it is now considered more economical to use combines, harvesting "on the run." Threshing as much as 30,000 bushels a day, from 10 to 20 combines are drawn around the enormous fields. An arm with a spread of from 20 to 30 feet cuts the wheat and passes it into the thresher, which pours the grain into a hopper or into a wagon attached to the combine.

Harvesting with combines was impractical under certain conditions, and to remedy this objectionable feature Mr. Campbell developed the "windrow," which is recognized as one of the most important advances in harvesting since the invention of the binder. Using four partly dismantled binders drawn by a light tractor, a 40-foot swath of grain is cut and transferred unbound to a long row, where the loose grain is allowed to mature for a few days before threshing. Then a combine is hauled down the long row, picking up the grain with a hay loader, and threshing it in the usual manner. This method effects a saving of two dollars an acre on harvesting costs, compared to the old method with binders, bound shocks, and stationary threshers. Due to the extra width of the spread or swath cut, the cost of the two windrow operations is comparable to that when combines are used in the regular manner.

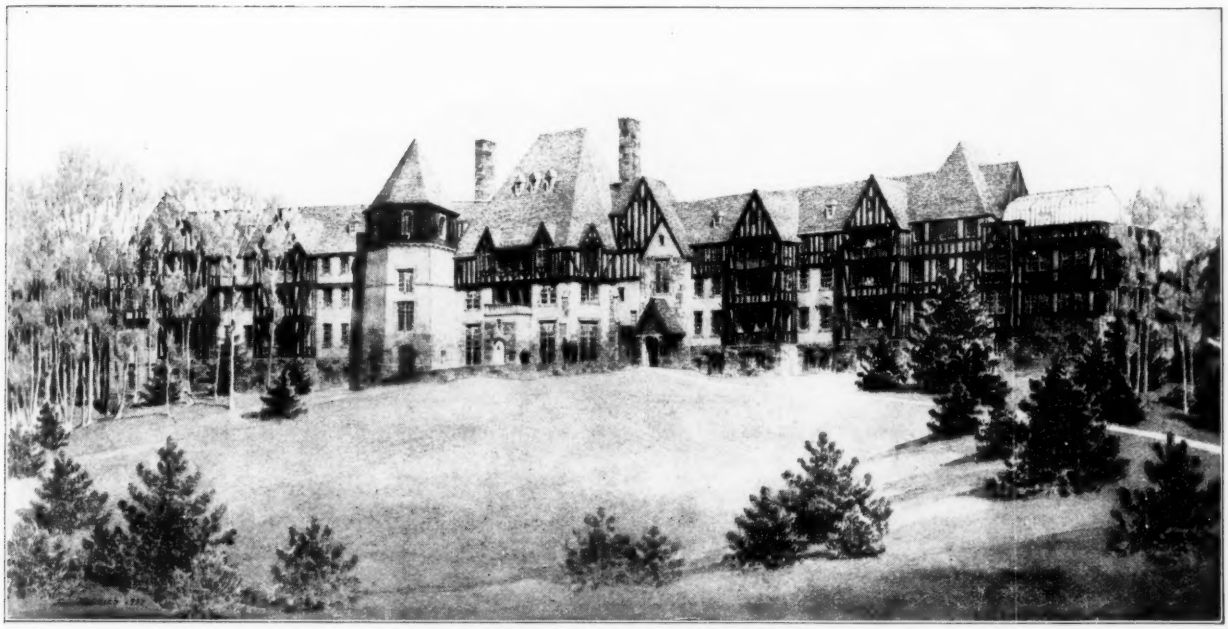
LONG wagon trains drawn by tractors, supplemented by motor trucks equipped with large bins and drawing two trailers, transport the grain to the railroad, elevators, or storage bins. Most of the Campbell grain goes to Minneapolis, the largest flour producing city in the world. Millers feature flour made with Montana wheat, and pay extra premiums for the Montana grain because of its unusually high protein content. The premium on high-protein wheat varies from two cents to about 30 cents, according to the milling demands and the abundance of the premium grain. On the Campbell properties near Hardin there is storage space for about 150,000 bushels of grain, for protection against an unfavorable market.

When one contrasts the high-speed, mass-production methods of modern industrialized agriculture with the more leisurely, more enjoyable, but obviously less economical practices still in vogue in most of our agricultural regions, it is not hard to realize that 30 percent of our farmers produce 80 percent of our crops and livestock. During the past 20 years about five million people have left the farms, but the total agricultural output has increased; by 1950 there will probably be about 150 million people in the United States, and they will be fed by fewer farmers than were required in 1850 to feed only 25 million people. Three men operating a tractor combine can do the work of 18 threshers, and it now requires only 10 minutes of human labor to produce one bushel of wheat whereas it formerly required about three hours.

What the farmer really needs, in the opinion of the world's largest wheat grower, is better machinery, improved inland waterways, closer co-operation between farmers and business men, more agricultural research, education regarding economical production methods, tariff protection, better co-operative marketing associations, and improved equipment to provide cheap power for farming operations. Anyone who intelligently follows the advice of the Department of Agriculture and the agricultural colleges can make farming pay, especially if trained in engineering practices. Mr. Campbell expects to be operating his tractors with individual electric motors supplied with power distributed from a central generating plant on his farm, within another 10 years. In the meantime, he considers the Diesel engine the most economical power source for use on farms.

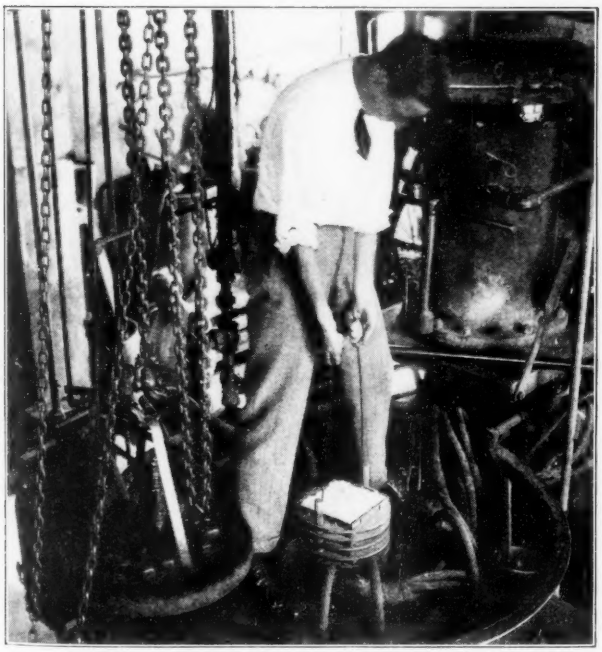
It is Mr. Campbell's belief that the greatest industrial opportunity of the present time is in agricultural engineering, both as a life work and as a sound financial investment. In a recent issue of *Mechanical Engineering*, the editor said, "Mr. Campbell's experience indicates that the application of machinery on a large scale is successful in producing wheat and flax at low cost. It is logical to believe that the principles he has developed and used so successfully can be applied to other farm products. As engineering skill has made over industry generally, so it can remodel agriculture, transforming it from a method of making a living to a sound industry that will attract the best brains and capital."

Fuzed Quartz for Ultra-violet Rays



THE NEW FUSED QUARTZ SOLARIUM

The enclosure, entirely of quartz panes, is shown (upper right hand corner) on the roof of the National Vaudeville Artists' Sanatorium



PLACING TRAYS OF CRUSHED CRYSTAL QUARTZ IN FURNACE

INSPECTING PANES OF THE FUSED AND FINISHED PRODUCT

IN order to permit patients to receive indoors the maximum percentage of the especially valuable short wavelength ultra-violet radiation of the natural sunlight the sanatorium shown above, at Saranac Lake, New York, has installed an expensive solarium walled and roofed entirely with panes of fused quartz, 1200 of them, each 7½ inches square and ¼ inch thick. Common window glass, transparent to the visible rays of light, is almost totally opaque in the short-wave ultra-violet part of the spectrum. Various special glasses and glass substitutes transmit up to about 50 percent of these rays, while fused quartz transmits the greater part of them. The quartz panes were made by the General Electric Company, using a special technique developed by Professor Elihu Thomson of that company, who is also a Corresponding Editor of this journal. Quartz is difficult to work because it melts only at 3200 degrees, Fahrenheit—three times the temperature required to melt glass. Even then it is thick, ropy, and viscous. In making the window panes, natural quartz crystal is crushed to ¼ inch mesh size and spread on graphite trays between graphite slabs. Several trays are stacked as shown above, placed in a high temperature furnace and fused. The troublesome bubbles imprisoned in the mass are compressed to a minimum size under 150 pounds per square inch of inert gas (nitrogen) admitted to the furnace. The panes are cooled, their edges are squared by grinding, and they are ready for use.

Your 1930 Car

A Survey, in Brief, of Developments, Improvements, and Changes in Design of Some of the Better Known Cars

By F. D. McHUGH

WHEN you come to the task of selecting your new car this year, you will find that you have taken upon yourself a more difficult job then heretofore—unless, of course, you are partial to a particular make. Practically all the better known cars have refinements that will appeal to your desire for speed, for safety, for appearance, et cetera; but, in general, many of these features balance each other in different makes so that, to a large extent, you will have to guide you only the limitations of your purse and the knowledge you already have as to car performance and reliability.

And yet with all the refinements that have been made, mechanical improvements this year are not numerous. Some outstanding ones, however, indicate the intention of the manufacturers to build for you an ever finer, safer, more powerful, or more attractive car.

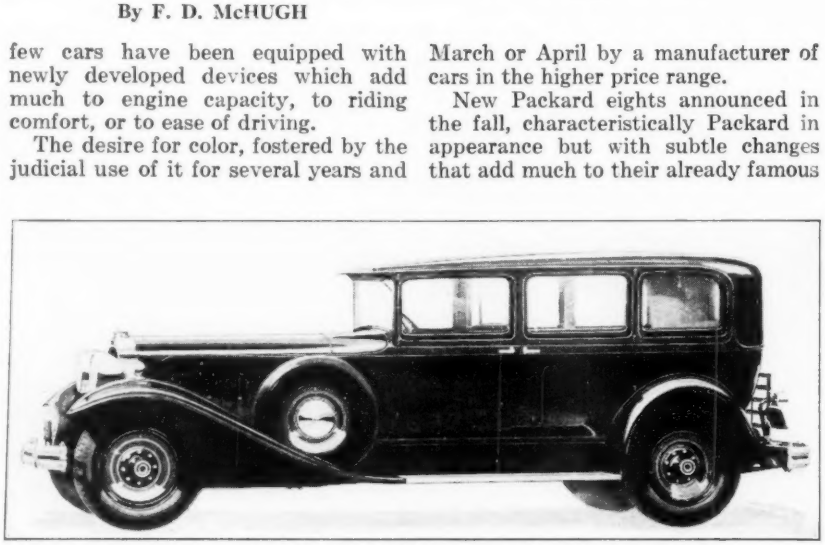
ON page 9 of this issue, Mr. C. F. Kettering outlines this development problem and describes the constant research that it is necessary for the manufacturer to conduct, but he does not stress the fact that whatever improvements are made come very gradually and almost unknown to the average motorist. We shall therefore outline briefly what appear to us to be the most noteworthy refinements and improvements that have been made recently and others that are to be announced shortly.

In general, it may be said that improvements are limited to such details as spring shackles, carbureters, rumble seat doors, and the more general adoption of four-wheel brakes, of safety glass, and of other safety features. Several manufacturers, however, have greatly increased engine power. A few cars have been equipped with newly developed devices which add much to engine capacity, to riding comfort, or to ease of driving.

The desire for color, fostered by the judicial use of it for several years and by almost a sunburst effect in the cars of 1929, is proving to be no fad but a method of expressing the car owner's individuality. In 1930 there will be a marked increase in color used on many cars. In fact, color has become such an important factor in the production of automobiles that manufacturers have employed color directors—artistic experts who know how to harmonize color combinations with individual designs.

Before going into further detail, we wish to refer you to the article on the Cord front-drive automobile on page 28. This is the most radically new design in American passenger automobiles for 1930. Besides this car, several makers of sixes have recently announced production of new eights and it is rumored that others will come into the market soon. Also, it has been stated authoritatively that a new 16-cylinder passenger car will be announced in March or April by a manufacturer of cars in the higher price range.

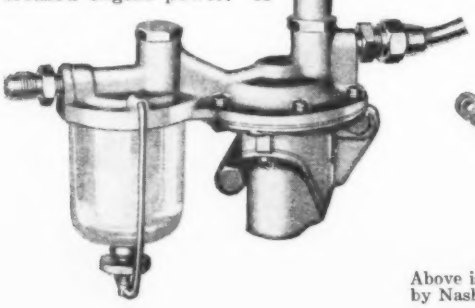
New Packard eights announced in the fall, characteristically Packard in appearance but with subtle changes that add much to their already famous beauty, have several outstanding improvements. Both the driver's seats and the steering wheels are adjustable. Unusual vision is given in the front compartment by a front body pillar that has been narrowed, yet retains the same body strength. All windshields and windows are of non-shatterable glass. The left front spring trunnion, developed by this company a year ago to eliminate "shimmy" and wheel "whip," has been retained. The chassis lubricating system has been extended to include 43 points on the chassis which are oiled every day by turning a pump handle mounted within easy reach at the base of the steering column.



PACKARD LIMOUSINE AND PISTON OILER

The luxurious seven-passenger sedan limousine presents a striking appearance. At the left is the choke-operated valve which sprays oil into each cylinder

PACKARD has also developed a new carbureter which is said to have many advantages in smoothness of operation, acceleration, safety, quietness, economy, and easy starting. Steel-backed bearings and several other features found by the company to be of advantage in building airplane models are incorporated in the new engines. As in previous Packards, the



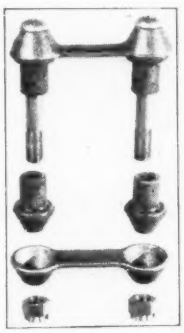
NASH DEVELOPMENTS ON THE TWIN-IGNITION EIGHT

Above is shown the manner in which the springs are steel-jacketed on the new eight announced by Nash. At the left is the gasoline filter and fuel pump which makes positive fuel feed possible

pistons are automatically lubricated when the choke rod of the motor is pulled out, an arrangement which pumps oil onto the cylinder walls at the time it is most needed.

With three complete lines, each comprising 11 different types, and an almost unlimited choice of individual custom bodies by the best body builders, Packard may now be said to cover completely the fine car field.

One of the eights recently announced by a maker of sixes is the Nash twin-ignition straight-eight which the Nash Motor Company claims is the first of its kind in the world. Included in the announcement were details of a twin-ignition six and a single six. The new eight is powered by an eight-in-line twin-ignition, valve-in-head, nine-bearing motor with an integrally counterbalanced, hollow-pin crankshaft; with aluminum alloy Invar-strut piston and aluminum alloy connecting rods capped at the crankshaft with case-hardened steel. It develops 100 horsepower.



NEW features of the Nash eight include: steel-jacketed lifetime-lubricated springs, individually tailored to the weight of each car; cable-actuated internal-expanding four-wheel brakes which are self-energizing forward and backward; thermostatically controlled radiator shutters; Bijur centralized lubricating system to oil, by pressure on a foot pedal, 21 chassis points, including shackles; dash-bottom starting controls; et cetera.

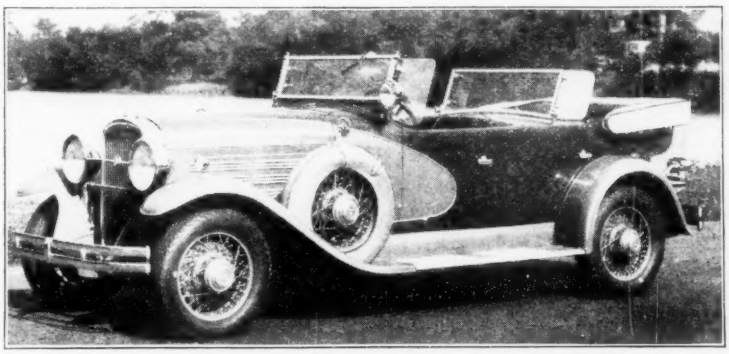
Various mechanical and body refinements have been incorporated in the Nash eight. These include aircraft-type spark plugs, positive fuel-pump gasoline feed, solid chain-operated camshaft, improved clutch, and road-shock insulator. Most of these features will be found also in the two sixes while both the eight and the sixes have non-shatterable glass in windows and windshield.

Hupmobile is another producer of a new eight in the medium price class. This car is manufactured in five body styles, one of which, the cabriolet, has a patented top construction. The new eight develops 100 horsepower, is said to attain an 80-mile-an-hour speed, and accelerates rapidly.

In these new Hupmobile eights, the radiator is higher and narrower, has built-in shutters, a new emblem, and a narrow chromium-plated shell. Among other improvements, this car has also adopted the road-shock eliminator attached to the rear end of the left front spring, and force-feed lubrication to all main, connecting rod, and piston pin bearings—46 points in all.

A third new eight is the Gardner with an eight-in-line motor and optional four-speed transmission. This new car comes in two series, in each of which there are eight models. Information concerning mechanical details of this new eight are not available but it is said to have several improvements.

Several features of the "Great Line Ninety," an eight by Jordan, with a 75 horsepower, eight-in-line motor, reflect this company's claim of "scientific engineering." This eight has a crankshaft that is both statically and dynamically balanced and is therefore free from periodic vibration; it has pressure lubrication of main and connecting rod bearings, a double breaker ignition distributor, and other distinctly Jordan developments. Other features are: soft type chassis springs of special alloy steel, Houdaille shock absorbers, seat cushion springs which are said to be synchronized with the chassis springs, and new patented



JORDAN "PLAYBOY" AND SPRING SHACKLE

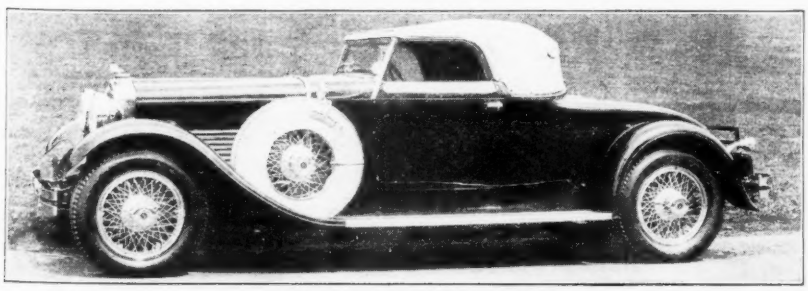
An attractive sport touring car. At the left is shown the rubber insulated spring shackle, disassembled to show parts. Rubber sections are dark

shackles, mounted in rubber to eliminate rattles and squeaks.

The Stutz Motor Car Company continues to stress the built-in safety features of Stutz and Blackhawk cars. The contribution to safety of the low-slung bodies of these two cars—made possible by the worm gear drive; of the safety glass used in both; of side bumper running boards; of four-speed transmission; and of the vacuum booster on the hydraulic brakes of the Stutz, has been added to within the year by the Noback, an exclusive Stutz engineering achievement which is now on both the Stutz and the Blackhawk.

THE Noback, which the writer considers one of the most important contributions to car safety to be developed in recent years, is a brake with an automatic actuating mechanism. Installed between the rear of the transmission main shaft and the parking brake drum, this device prevents dangerous backward rolling of a Stutz or Blackhawk when a stop is made on an incline, so that it is entirely unnecessary to use the brakes for holding the car. To push one of these cars backward it is necessary to throw the gear-shift lever into reverse and then throw it back into neutral. The car may then be pushed or allowed to roll backward; but when a forward motion has taken place, Noback again holds the car as before until the operation is repeated. This company has also adopted, as optional equipment, the first stock supercharger to be used on anything but racing cars and airplanes.

Stutz has just announced a new streamlined aluminum-body speedster, the Torpedo, in which are incorporated many of the features of last year's Blackhawk. Four-speed transmission,



STUTZ, THE LOW-WEIGHTED

This model typifies the low center of gravity characteristic of all Stutz cars. Safety of all models is stressed because of the many safety features, the most recent of which is the Noback

KISSEL DELUXE BROUGHAM SEDAN

In this model may be seen the new "No-draft" ventilating rear side window, a close-up of which, in the open position, is shown in the oval illustration at the right

Noback, the new vacuum-operated hydraulic brakes, and low center of gravity, provide ease of driving and safety for the occupants.

Balance and low center of gravity have become factors of major importance along with increase in engine power and speed. Thus the announcement of Studebaker that the new President eight and Commander eights and sixes are built with double drop frames, reveals a noteworthy development in both safety and balance for the Studebaker line. The low over-all height and low center of gravity made possible by this double drop frame, together with the recently adopted non-shatterable glass for Studebaker windshields, represent the most recent improvements in this line of cars.

THE Kissel Motor Car Company has adopted for all models in series 95 and series 126 a four-speed transmission which the company says is the result of two years of experiment and research work. The result achieved is smoothness of operation and improved road performance, a slowing down of engine and propeller-shaft speeds, and, consequently, decreased vibration. The only other mechanical improvement in series 126 is the adoption of Lovejoy shock absorbers. The bodies of some Kissel models have been enlarged and body lines have been revised. The 1930 De Luxe Brougham has a new style of ventilating rear side window. Exclusively a Kissel feature, this window swings on hinges like a residence casement window. The rear oval window of this model lowers the same as the door window glasses.

Duesenberg, Inc., displayed at the Chicago salon in November nine models built on the regular 265-horsepower Duesenberg chassis. Many new and luxurious features have been incorporated in these new bodies, three of which are by Murphy, two by Willoughby, and one each by LeBaron, Weyman, Derham, and Judkins.

Marmon has re-entered the fine car field with the production of the Marmon Big Eight. Powered with a straight-eight engine of 125 horsepower, this car is equipped with four-speed transmission and especially designed mechanical features such as: a double-dome cylinder head; invariable mechanical four-wheel brakes with cable linkage completely enclosed in lubricant-packed, sealed metal conduits; and mono-control windshield.

ADDITION of this car, built in nine body styles for the higher price class, enables the Marmon Company to blanket the price field since it already produces the Roosevelt in the low price range and the Marmon 66 and 78 in the medium price range. Further information concerning new models will be given out early in 1930.

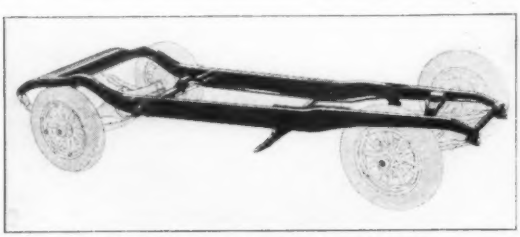
The 1930 Buick will be offered in 14 models in three series known as the "40," "50," and "60" Series. Longer wheel-bases; lower, longer, and more beautiful bodies; and many mechanical improvements and refinements characterize these new Buicks. Additional power is given by the increase of ⅛ inch in the cylinder bore of engines of all models. Other advances achieved are: semi-elliptical rear springs; double-acting shock absorbers; sloping, non-glare windshield; re-designed transmission and clutch; larger rubber motor mountings; thermostatically controlled radiator shutters; and a wider frame. The carburetion system has been improved by a newly designed gasoline pump and the elimination of the low-speed carbureter adjustment.

No radical changes have been made in the duPont. The eight models of the new eight which were recently announced are distinctive in design, showing as they do the French body style influence. They have a higher radiator and cowl, with heavily crowned fenders brought to a point in front.

Three new Chryslers, the "77," "70," and "66," were recently added to this well-known line. Noteworthy features in the "77" and the "70" are: multi-range, four-speed gear shift; a down-draft carbureter; larger and more powerful engines; Paraflex spring suspension; and chimney-type, rubber, shock insulators.

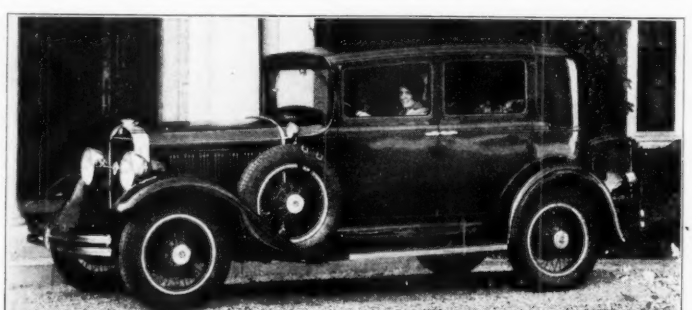
IN the "down-draft fuelization" system, the carbureter is mounted above the engine instead of at the side, thus allowing a gravity flow of the explosive mixture.

Another new feature found in these two series is the de-carbonizer, a device employing a new fluid called Carbosalve for dissolving the engine carbon deposits. This device includes a fluid container mounted on the dash under the hood, a connection to the inlet manifold, and a plunger located on the dash. With the engine running, a quantity of the fluid is sent into the cylinders by means of the plunger. After the engine rests several hours and is then started up, the dissolved carbon particles are blown out the exhaust. Chrysler has also adopted a



STUDEBAKER CHASSIS AND MODEL

Above is shown the new double-drop frame which gives a low center of gravity and reduces body-line height of the President eight and Commander eights and sixes. At right is the Dictator Eight Brougham

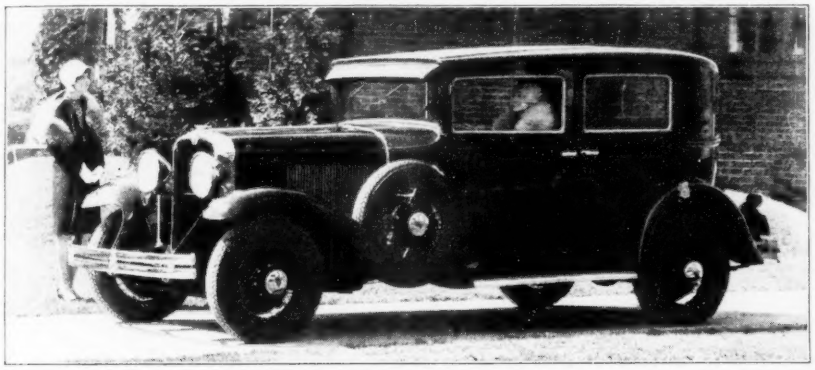


rust-proofing process which is claimed to insure a permanent finish and longer life for fenders and other exposed parts. An interesting Chrysler innovation is the rumble seat door which has been added to the Imperial roadster.

Pierce-Arrow, in 1930, will build three groups of cars, all of them straight-eights, although no changes will be made in general appearance or body design. In these cars will be incorporated several improvements over current production which, as a matter of fact, is new, since Pierce-Arrow's first straight-eight car was introduced early in 1929. Among the refinements are some which affect the manifolding; and the latest improvement—a very important one—is the adoption of stainless steel for more than 350 parts including small pieces, nuts, and bolts which would ordinarily be subject to rust or corrosion.

BUICK WILL COME IN 14 MODELS

The 1930 Buicks will have longer wheel-bases and be characterized by many mechanical refinements. Their engines have been given increased power by a larger cylinder bore

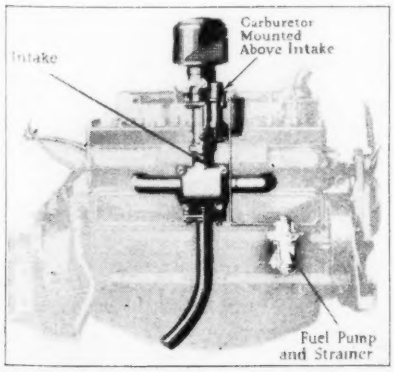


VIKING EIGHT BROUGHAM

This four-door brougham is one of three new models which will be displayed at the annual automobile show in New York in January. Improvements will be announced then

Striking body designs will feature the exhibit of the Oldsmobile six at the New York Automobile Show. The body types on display will include the four-door sedan, two-door sedan, business coupe, sport coupe, convertible roadster, and phaeton, in standard, special, and deluxe models.

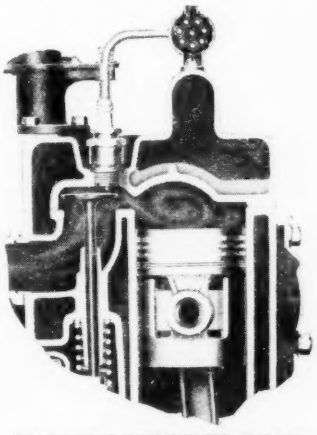
The Viking eight, companion car of the Oldsmobile six will be seen in three distinctive models at this show. Designed by Oldsmobile engineers with the resources of the General Motors research laboratories and proving ground at their command, the Viking has improved engine design.



CHRYSLER FUELIZATION SYSTEM

"Down-draft carburetion" is said to give more power, speed, and easier starting

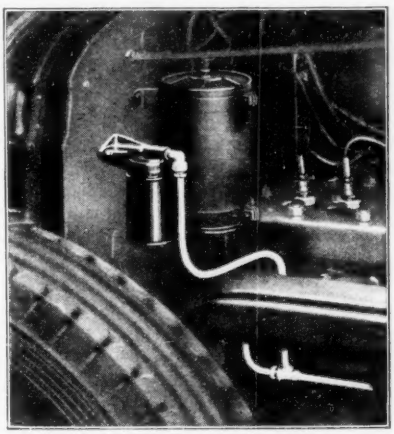
We wish here to extend our thanks to the companies already mentioned for their co-operation with us in the preparation of this article and to express our appreciation to the following who have made an effort to supply us with material but could not release it early enough: Willys-Knight and Whippet, Chevrolet, Auburn, Oakland, the Dodge-DeSoto-Plymouth line, Peerless, and Stearns-Knight. Those who had no information available before the first of the year are: Franklin, Cadillac and LaSalle, Hudson and Essex, Ford and Lincoln, Durant, Moon, Graham-Paige, and Reo.



MARMON CYLINDER HEAD

A sectional view of the new double-dome cylinder head of the new Big Eight

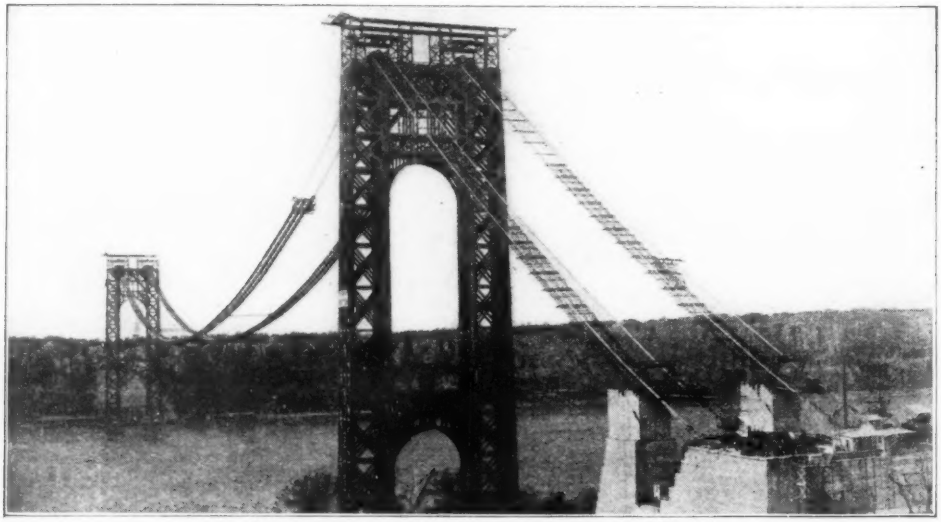
A review of the automobile field gives the impression that manufacturers anticipate no great let-up in car buying in 1930 despite the recent disastrous stock market crash. It has been asserted that whatever effect it may have had will shortly be offset by a normal car sale and that the output in 1930 will be greater than ever.



CHRYSLER DE-CARBONIZER

Mounting of the new device designed to keep the engine always free of carbon

Most of the 1930 cars, at least in the medium and higher price range, it will be noted, are finer, more luxurious, or so greatly improved as to indicate the belief of the manufacturers in the continuation of our general prosperity. In the low price field, the prices of the 20 models of Fords have been lowered by amounts varying from 15 to 200 dollars. To explain this, Edsel Ford is quoted as saying, "It is our belief that, basically, the industry and business of the country is sound. We are reducing prices now because we feel that such a step is the best contribution that can be made to assure a continuation of good business throughout the country."



ALMOST READY FOR SPINNING THE CABLES

When this photograph was taken, the catwalk cables had been raised to position and the catwalk was almost complete. A carrier, loaded with sections of which this walk is built, may be seen on center span

Four Cables: 106,000 Miles of Wire

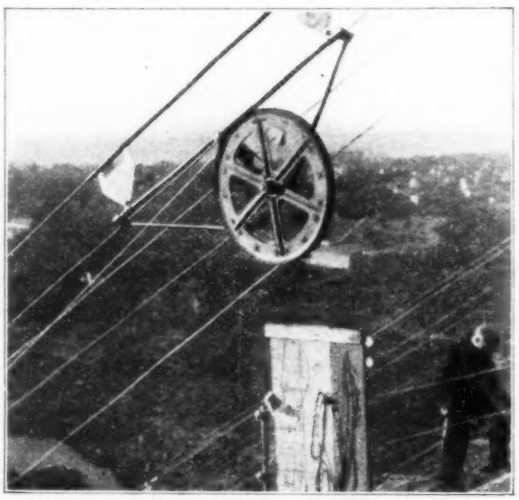
As Spinning of Cables Begins, the Hudson River Bridge From New York City to New Jersey Becomes a Giant "Loom"

By A. E. CRIPPS*

HIGH above the icy waters of the Hudson river workmen are now spinning the steel wire cables from which will be suspended the roadway of the huge bridge which will soon connect the states of New York and New Jersey. Going about their appointed tasks like human spiders, these fearless men, indifferent in the face of danger made doubly dangerous by the ice on the catwalks, guide the spinning wheel as it weaves its way back and forth across the river, seize the individual wires, and clamp them into place at proper intervals. Day after day for a year the wires will be spun from the Palisades to Riverside Drive and back again without cessation until the 105,896 wires are strung into place.

In a previous article (December, 1929, SCIENTIFIC AMERICAN.—*Editor*) the preliminary work attendant upon the erection of the main cables was described. That article ended with the stringing of the catwalk suspender ropes. After these ropes were in position it was necessary to install the suspended structure and floors of the catwalks. This work was carried out by the use of carriers which rode upon the ropes, traveling from the top of either tower and loaded with catwalk sections. The carrier was lowered to the center of the span by means of a motor driven windlass; and, starting from the center, the catwalk sections were placed in position one by one.

The catwalks on the back, or end, spans between the towers and the anchorages, have been made in a series of steps with landings, because of the steep angle of the cables in these positions and the hazard to the men.



THE SPINNING WHEEL

Two of these work continually on each of the four cables, traveling back and forth across the bridge many times carrying wires that will form the cables

There are two catwalks, or footbridges, each of which is to take care of the spinning of the two cables on a side; each is 25 feet wide, made up of a light steel frame, covered with wood planking. Heavy wire netting is placed over the gaps, not only to lessen danger for the men, but to prevent loss of tools into the river below. In the main span, five crosswalks connect the two catwalks so that workmen may pass from one to the other without the necessity of going up to a tower and crossing over.

In spinning the cables, two batteries or sets of reeling machines, each composed of four reels, are placed on each side of the river so that, altogether, there are 16 reels of wire working simultaneously. Special reels have been constructed from steel channels and boiler plate, each to contain 160,000 feet of wire. These are placed on a freight car near the reeling machines and are then pushed into position and lifted onto the machine by means of an electrical lifting device which centers the reel and allows it to revolve.

To facilitate handling of the wires as they are spun, each cable will be made up into 61 so-called strands of parallel wire, each to contain 434 wires, making the total for each cable 26,474 wires.

* Of John A. Roebling's Sons Company

The connecting of the wire strands to the eyebars is made possible by means of steel castings known as strand shoes. These are constructed to hold the 217 loops of wire formed by the 434 wires of each strand. In the strand shoe there is a 10-inch hole through which a pin can be placed so that the whole assembly can be connected to an eyebar.

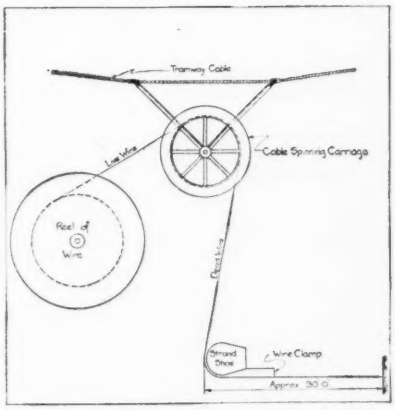
Four tramway systems have been erected, one for each cable. Each of these consists of an endless rope which passes from one anchorage, over the towers to the other anchorage, around a sheave, and back to the point of origin. These ropes are supported at 200-foot intervals by specially designed sheaves and towers; and in order to overcome any sag of rope between the sheaves, a tension carriage, which exerts a tension on the ropes equivalent to a pull of 12,500 pounds, is incorporated.

AS will be explained later, these tramway ropes will move continually across the river like giant traveling belts, the motive power being supplied by an electric motor which allows operation in either direction. Two spinning wheels or sheaves each four feet in diameter are attached diametrically opposite each other on each tramway cable loop; that is, when one wheel is on the New Jersey side of the river the other will be on the New York side.

The preliminary details being complete, the actual work of spinning the cables can begin. By referring to the diagrams captioned "The shuttle and loom," the following explanation will make the principle clear.

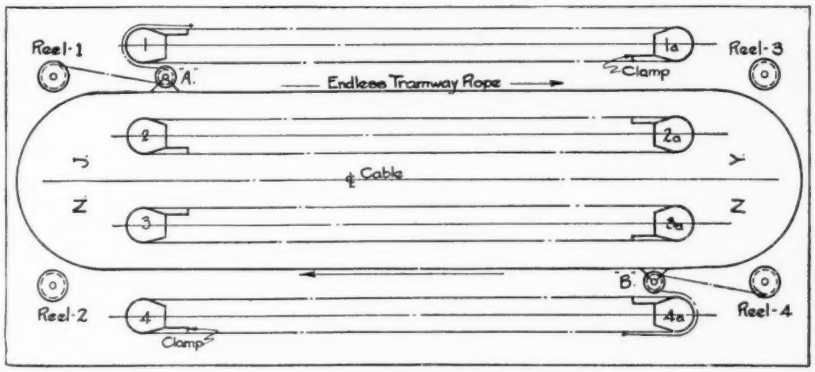
The spinning of the four cables must all be done at the same time so that the weight of the wire placed on the towers —constantly being added to as the wires are pulled across—will be equal at all times. Bearing in mind that the spinning is conducted from both sides of the river simultaneously and that the speed of the reeling machine is synchronized by hydraulic equipment with the speed of the tramway on which the spinning wheels travel, we are ready to begin operations.

For the first trip, which took place October 21, 1929, the end of the wire was taken from reel Number 1 on the New Jersey side, and joined to Number 1 strand shoe (see diagram). The loop thus formed was placed over the "spinning" wheel, or traveling sheave "A" attached to the endless hauling rope or tramway cable. The same procedure was followed on the New York side, a wire being connected to strand shoe Number 4-a and the loop thus formed placed over sheave "B."



THE SHUTTLE AND LOOM

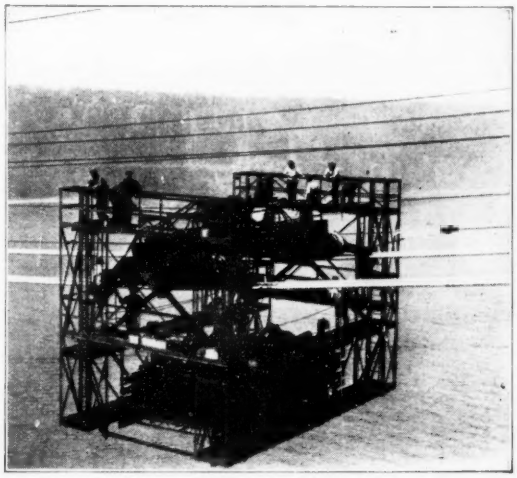
The diagram at the right shows the manner in which a wire is taken off a reel, passed over the spinning wheel, and fastened to the strand shoe. The diagram below, flattened out for easier reading, is described in detail in the text



As the endless rope traveled, sheave "A" with its loop was carried to the New York side, while sheave "B" went over to the New Jersey side. When "A" reached its destination, the loop of wire was taken off and placed on shoe 1-a. At the New York anchorage another loop was then formed from reel Number 3, the end being fastened to strand shoe Number 2-a. Shoe "A" then traveled back to its first position, passing on the way sheave "B," which had performed the same operation on the New Jersey side. The loop taken from reel Number 3 was carried across and placed over strand shoe Number 2, while the loop on sheave "B" which was taken from reel Number 2 was then carried to the New York side and placed on strand shoe 3-a. Each trip of the spinning wheels, the two going in opposite directions at one time, takes approximately 10 minutes.

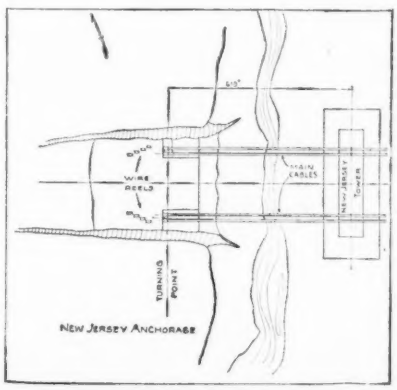
The stationary wire—that is, the branch of the loop the end of which was attached at the starting point—was successively adjusted behind the spinning wheel so that it hung at a predetermined sag in the first side span and in the main span. After the loop was placed around the strand shoe at the far side, the dead wire was successively adjusted in the last side span, the main span, and the first span. It was then placed around the strand shoe at the point of its beginning, thus forming another loop to be pulled across by the spinning wheel.

This operation will be repeated for each strand until the 217 loops, or



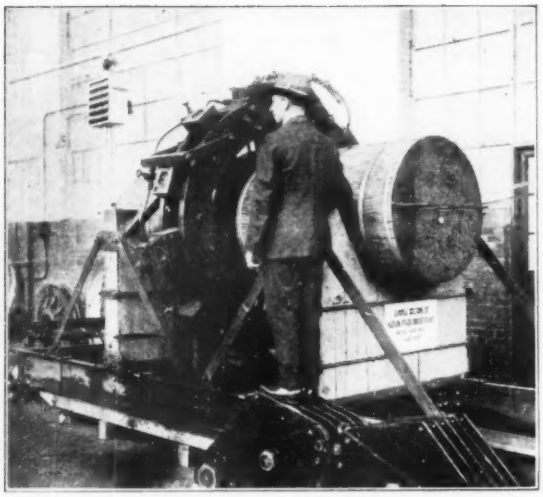
BUILDING THE CATWALK

One of the carriers which were suspended from the catwalk cables and used to construct the walk itself



THE WIRE REELS

The New Jersey approach to the bridge, showing location of the reels of wire



HYDRAULIC JACK PRESS

A sample section of cable the size of the Hudson bridge cables, and the device which will press them to shape

pairs of wires which go to make up the strand, have been placed. On reaching the end of the last loop of the strand, the end of the wire is then connected to the beginning of the first loop. The completed strand thus formed is therefore a continuous length of wire approximately 428 miles long. Instead of returning the wheel empty to its point of origin it is used to pick up a wire loop from a second reel, thus beginning a new strand.

Each spinning wheel travels 209 miles in spinning one strand, or a total of 12,749 miles in spinning each main cable; and, since there are four such cables, there will be an approximate mileage of 50,996 miles traveled by the spinning wheels in fabricating these four cables—a distance comparable to twice around the earth at the equator.

AS the strands of each of the four cables are spun, the individual wires are seized and placed in their predetermined positions on the tower saddles. The first strand of each cable is adjusted to the correct deflection and the proper sag is determined by means of precision instruments. The remaining strands are then placed in correct relation to the first as they are spun, and irregularities in length are adjusted by means of shims—thin steel plates—at the strand shoe located at the anchorage.

The above procedure is carried out with each of the strands until the total of 61 which completes one cable is in place. With the full number of strands in place, bunched together, the cross-section of each cable at this stage is hexagonal. It is of interest to learn that the deflection in the center of the span changes about 25 feet during the spinning of these great cables and that the towers compress two inches during the loading.

The next step is the compacting or squeezing of the cables to give them a circular cross-section. This will be done by means of a circular frame in which are mounted in radial formation 12 hydraulic jacks, each of which actuates a concave-faced shoe. This compactor is capable of exerting a pressure of 720 tons although it may be necessary to apply only 300 or 400 tons. The compactor is first applied at the center of the main span encircling the cable, and then half way up each side of the main span. Pressure is then exerted at approximately each 200 feet and finally about every three feet. This method has been decided upon as the best method of preventing "bunching" of the strands at the tower saddles.

While the compactor is squeezing the cable, a wrapping of wires will be made on each side of the compactor in order to hold the cable into its final cylindrical form. This is called "seizing."

FROM this point, cable bands of cast steel will be placed at regular intervals along the length of the main cables to carry the suspender ropes. (These suspender ropes will be cut from the ropes which now carry the catwalks.) After the cable bands are in place, the suspender ropes will be fitted to them by means of special bridge connections. These ropes will support the roadway susperstructure.

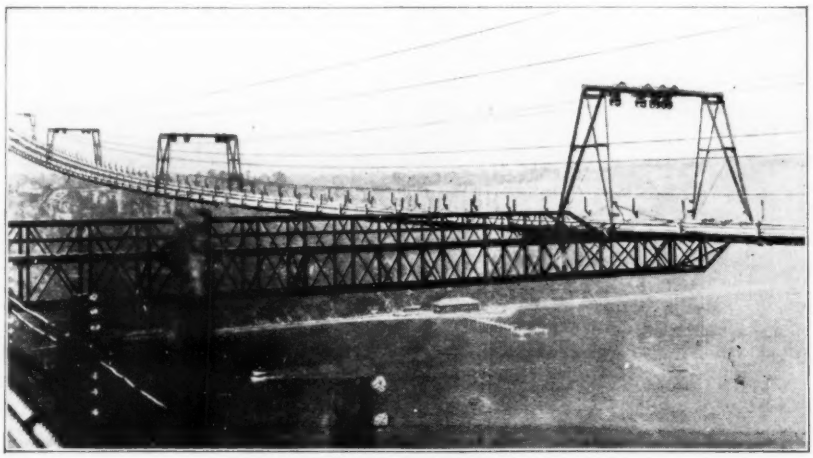
When part of the dead load of the superstructure has been placed on the cables, they will be wrapped concentrically with a soft galvanized wire as a protection againt rust and corrosion. The cables will then be given several coats of paint as a further protection, and everything will be ready for the final touches to be put to the structure.

New methods have been invented by the engineers of the John A. Roebling's Sons Company to speed the spinning of these mammoth cables, and although the system employed in spinning is primarily the same as was used by them on such structures as the Brooklyn and Williamsburg Bridges, later improved methods and design will speed up the work considerably.

This speeding up of the work of spinning is strikingly shown by a comparison of the 21 months' time it took to spin the relatively small cables of the Brooklyn Bridge with the short time of one year which will elapse before the cables are ready to receive the superstructure of that new monument to American engineering ability, the Hudson River Bridge.

COMPLETING THE CATWALK

Wire netting was placed between the sections of catwalks. Note uphill slope



ONE OF THE CROSSWALKS

Five of these walks were installed on the center span of the bridge between the two catwalks. They serve as a convenience for the workmen and to make the temporary structure rigid

Expediting Truck Deliveries

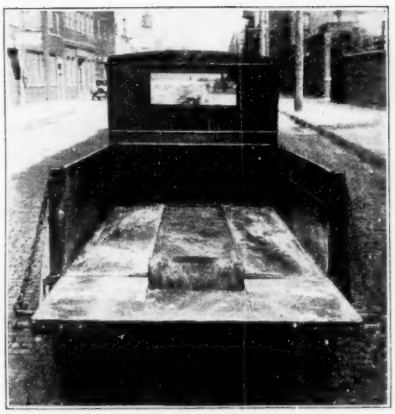
Conveyor Belt Unit on Truck Delivers Load With Ease and Speed

IN present practice, the load in an ordinary motor truck body is dumped by means of a power hoist of some sort, either hand or hydraulically operated. Under favorable circumstances the load may be dumped through a manhole in the pavement and the material placed directly in its storage space or the load is dumped on the ground and recovered by hand and shovel power. In the latter and more usual instance this means an extra handling of the load with the consequent additional expense.

A new self-unloading motor truck body, recently placed in production, is designed so that the material can be placed directly in the storage space. This body is firmly attached to the chassis and arranged with its bottom slanting from each end toward its center. In the center is a conveyor section which, in turn, is connected with a hinged conveyor attached to the body outlet in such a manner that the flow of the material is mechanically forced. The actuating power is derived from the transmission of the truck.

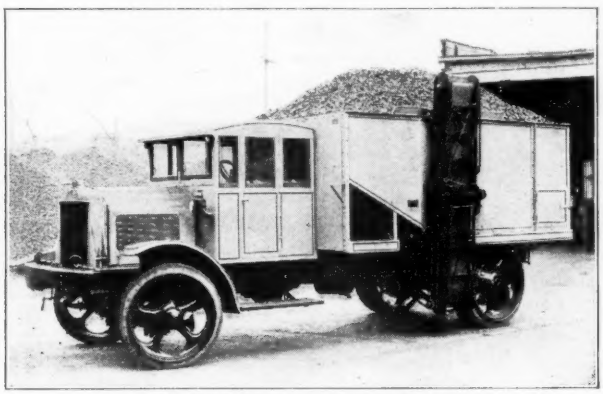
In obtaining this power an additional clutch is necessary and this is governed by a lever in the cab at the right of the emergency brake lever. The clutch is in a housing attached to the main transmission housing. When the lever is moved, the propelling shaft clutch of the vehicle is disengaged and the additional clutch comes into play.

Since the truck body is stationary, the elimination of a hoisting device reduces the dead-weight of the truck by more than a ton without reducing the strength of the body. The bodies are built for any chassis from two and a half tons up to the largest size.



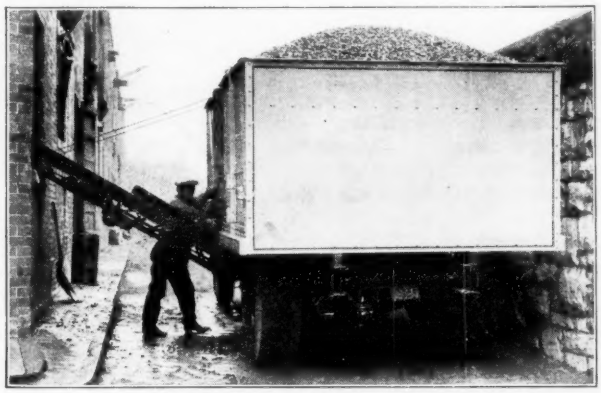
NON-TILTING TRUCK BODY

Small truck with floor arranged in rigid position, the conveyor covered



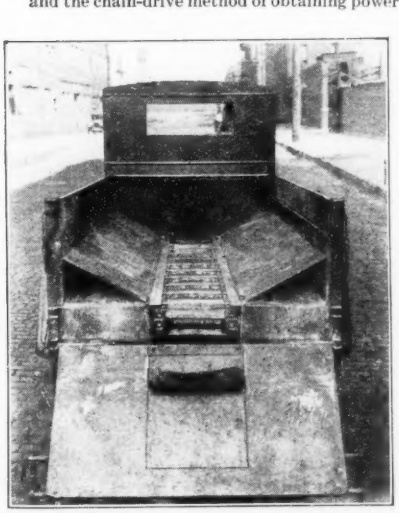
LARGE TRUCK AND ITS CONVEYOR

A 10-ton truck loaded with coal showing how conveyor is carried and the chain-drive method of obtaining power from the transmission



EMPTYING A LOAD "UPHILL"

Unloading 10 tons of coal into a bin, the opening to which is six feet above the ground. The driver regulates the speed of flow



THE DISCHARGE TROUGH

Conveyor for small trucks. It runs length-wise of floor; the sides are sloped

WITH this new device, trucks can be unloaded at a speed of one ton a minute and, under favorable conditions, this speed can be bettered. By using the outlet opposite to the conveyor-equipped outlet and reversing the conveyor section located in the bottom of the body the material can be run off the truck through an ordinary chute into a basement or into a receptacle below the street level, at a rate of two tons a minute. The chauffeur or driver can regulate the flow of material, running it fast or slow as required, as the speed of the apparatus is under his control.

Another advantage is flexibility in delivery. The truck may be placed close beside and parallel to the curb, thus allowing other vehicles to pass on the driveway. In delivering coal there is also the advantage that the coal entrance may be placed at almost any height in the wall, for the conveyor can be raised almost perpendicularly and still place the fuel in the bin with but little slowing up of speed.

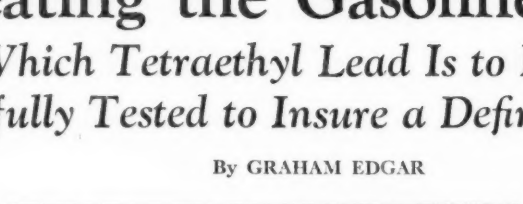
For a chassis under two and a half tons in capacity there has been arranged a modification of the idea just described. This arrangement is called the "all-purpose body" and the conveyor at the bottom of the body is placed to run lengthwise of it. The bottom of the body is raised at the sides, forming a trough through which the conveyor operates and when the body is needed for carrying lumber, ice, or other like material, the sides of the trough can be lowered in less than a minute, making an ordinary truck body available. Material that can be handled by conveyor apparatus can be unloaded from these small bodies at the rate of three tons a minute. The actuating power is also derived from the transmission and can be controlled just as effectively as in the larger bodies described above.

Defeating the Gasoline Knock

Gasoline to Which Tetraethyl Lead Is to Be Added, Must Be Carefully Tested to Insure a Definite Quality

By GRAHAM EDGAR

DURING the last few months thousands of visitors to the General Motors Pier at Altantic City have paused in front of a shining little gasoline engine mounted under a glass case and connected with various indicating instruments. They have watched levers move automatically and mysteriously, changing the engine's fuel from a red to a colorless one. They have heard the engine begin to "knock," and have seen the indicators register a drop in speed and power as the engine labors. Then again the levers move, the fuel is changed to the red liquid, the knock dies down and disappears, up comes the speed and power, and the engine purrs silently and smoothly. The red fuel contains tetraethyl lead, and the engine and its equipment constitute an automatic demonstration of the effectiveness of this now well known substance in eliminating the knock in an internal combustion engine.



COMMERCIAL KNOCK TESTER

With this small engine and equipment, gasolines are tested. These outfits are now being made and sold

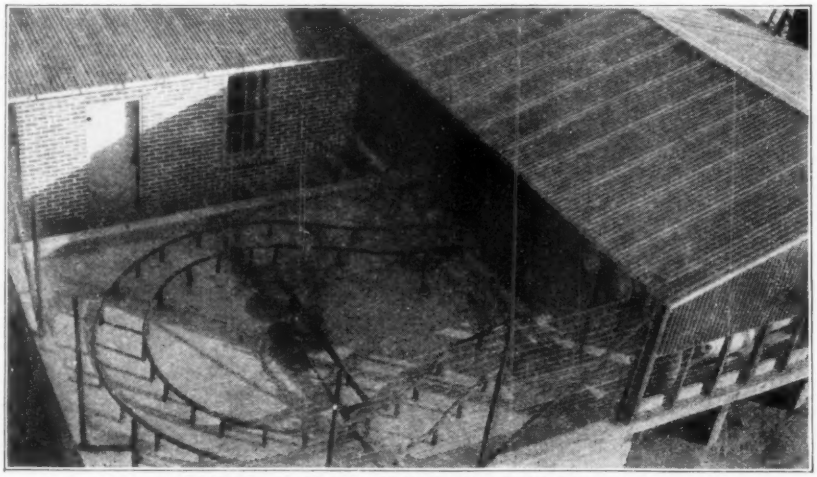
IT is doubtful if many of the visitors who witness the demonstration are at all familiar with the story of tetraethyl lead, or realize how, in a few years' time, this substance has come to play an important rôle in the oil and automotive industry.

The early investigations of the cause of the knock in automobile engines; the discovery that certain chemicals, added to the fuel in small amounts, were capable of eliminating this knock; and the many experiments which led to the discovery, by Thomas Midgley, Jr., of the most effective "anti-knock" known today—tetraethyl lead—would make an interesting story but one much too long for this article. But the developments of the few years which have elapsed since gasoline containing tetraethyl lead was first used commercially are worth a short story of their own.

On February 1, 1923, the Refiners Oil Company placed on sale at a single station in Dayton, Ohio, a new gasoline to which the name of "Ethyl gasoline" had been given. Automobilists who tried the new product, perhaps largely out of curiosity, little knew that the eyes of many engineers were focused upon this particular station, or guessed that the new gasoline was destined to influence profoundly both the oil refiner and the automotive engineer.

The little station at Dayton prospered, the new product seemed a success. One by one new stations were added, and other oil companies arranged with the General Motors Research Corporation to add tetraethyl lead to their own gasoline. In 1924, the Ethyl Gasoline Corporation was formed, not to sell Ethyl gasoline, but to take charge of the manufacture and distribution of "Ethyl fluid," the blend of tetraethyl lead and other ingredients which, when added to gasoline, converts it into Ethyl gasoline. Since that time one oil refiner after another has added Ethyl to his list of products, and today more than 60 refiners, selling altogether 65 percent of the gasoline used in the United States and Canada, are marketers of the different brands of Ethyl gasoline which the motorist finds throughout the entire country.

BUT the rapid increase in the use of this anti-knock gasoline is only a part of the motorist's debt to the investigators who discovered tetraethyl lead. The discovery of this substance focused the attention of the automotive engineer and the oil refiner upon the knock and its removal, and opened the way for increasing the efficiency of the automobile engine. For it has long been known that the most important factor in limiting the efficiency of the automobile engine is its compression ratio, that is, the ratio of the total volume of the cylinder and cylinder head when the piston is at the bottom of its stroke, to the volume when the piston is at the top of its stroke. The higher this ratio, the more power may be developed when a given amount of fuel is burned. But the knocking tendency of internal combustion engines limits the extent to which the compression ratio can be raised when using ordinary gasoline, for the knock brings with it a drop in power. Tetraethyl lead added to



ETHYL FLUID-GASOLINE MIXING PLANT

Drums of the fluid are rolled out on the circular track. Gasoline, pumped from a tank through transverse pipes, creates suction which draws fluid from pipe which leads from drum

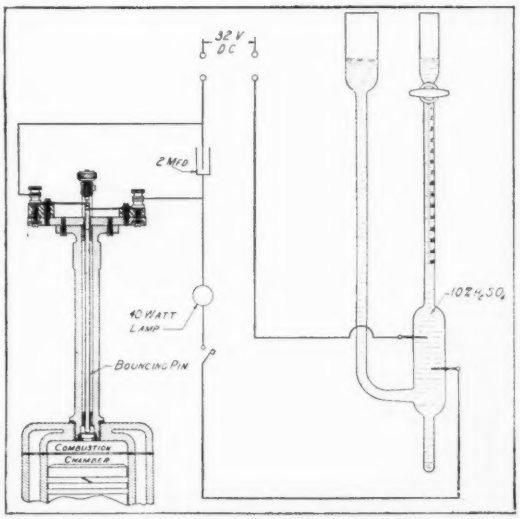
gasoline limits knocking and permits a higher compression ratio to be employed than could be used without it, thus resulting in increasing the power which a given amount of fuel and a given size engine could produce. And although all such developments must be gradual, it is interesting to note that the average compression ratio of American automobile engines (and hence the efficiency) has increased markedly in the last few years.

Furthermore, the oil refiner has had his attention directed to the anti-knock quality of his gasoline, and by carefully studying the different crude oils which he may have available and selecting the best of them; by developing and employing refining processes which improve the anti-knock value of gasoline; by utilizing tetraethyl lead; or by combining such methods; he has made available for the motorist and the automotive engineer fuels far higher in anti-knock value than any which were available a few years ago.

THIS result, however, has not been achieved without intensive work on the technical aspects of the problem. In the case of Ethyl gasoline, which is produced by blending Ethyl fluid with a wide variety of gasolines, it has been necessary to establish certain definite standards both for the quality—volatility, sulfur, gum, et cetera—of the base gasoline, and for the anti-knock value of the finished product, and to devise a mechanism by which these standards can be maintained by all of the different oil refiners who sell some brand of Ethyl gasoline.

To set these standards is easy; to maintain them is more difficult. The system which has been evolved has necessitated the establishment of a number of laboratories and the close co-operation of these laboratories with the various oil refiners. First there must be a laboratory at Deepwater, New Jersey, where tetraethyl lead is manufactured and blended into Ethyl fluid, and where it is determined that the concentrated product which goes to the oil refiner is uniform in quality.

Then there must be laboratories at strategic points to which the refiner may send samples of the particular gasoline which is to be blended with Ethyl fluid. These samples must be tested accurately to determine just how much tetraethyl lead must be added to them to make them equal in anti-knock value to the set standard. Only when these tests have been made, and the correct amount of anti-knock has been given to the gasoline, is the product ready to be sold as Ethyl gasoline. Finally, a corps of inspectors is continually on the road buying samples of the different brands of Ethyl gasoline and sending them to the nearest laboratory for checking, in order to detect any failure to maintain the standard.



"BOUNCING PIN" DETONATION TEST

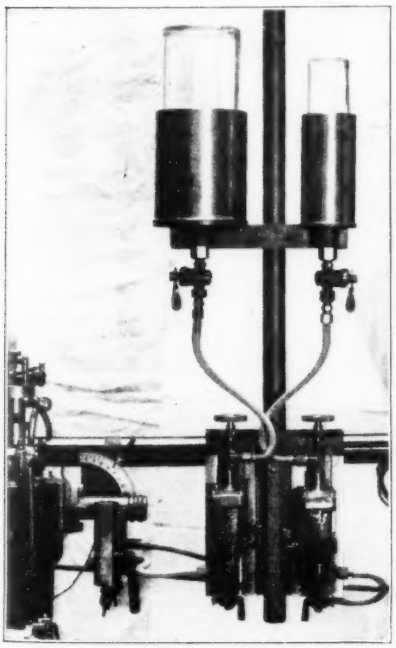
Explosion in cylinder bulges diaphragm on which rests a pin; pin is thrown upward, closing an electrical circuit; electricity passes through solution; and gas liberated in burette over period of time measures knock

IN this way the automobilist is protected from the danger of purchasing gasoline below a definite standard of anti-knock value, and the automobile engineer who desires to raise the compression ratio of his engine and thus increase its efficiency knows that at least so far as one commercial fuel is concerned, he can count on its meeting certain anti-knock specifications.

It may be of interest to explain how it is that the laboratory determined how much tetraethyl lead must be added to a given gasoline to give it a definite anti-knock value. The determination is not simple, and the working out of the technique has involved years of study. It has been necessary to develop and build engines specially equipped for the purpose. The engines employed by the Ethyl Gasoline Corporation laboratories (at Yonkers, Detroit, Omaha, and New Orleans) are single-cylinder affairs of very high compression. They are equipped with double carbureters to enable the operator to shift from one fuel to another; and with instruments for recording the intensity of the knock. Naturally, the conditions of the test — speed, temperature, et cetera—must be held very constant. The operator adjusts the engine to a moderate knock on a standard reference fuel, and records the intensity of this knock. He then shifts rapidly to the fuel under investigation and records again the intensity of knock. He then adds tetraethyl lead to the unknown fuel until he finds the knock exactly equal to that of the reference fuel. The double carbureter permits him to shift back and forth from reference standard to unknown until there is no doubt about the result.

But the work of the laboratories is not finished with the production and distribution of a satisfactory product. High compression, like almost any other engineering feature, presents quite definite problems. The most effective type of cylinder head, the location and design of spark plugs, materials for the construction of exhaust valves—these and many other problems have needed study. To promote co-operation between the oil refiner and the automotive engineer, the corporation has established an engineering research laboratory at Detroit which has aided the research organizations of many manufacturers in the solution of their problems. There are other problems also of a more chemical nature. The theoretical aspects of the knock and the action of anti-knocks, the chemical constituents of gasoline and their relation to its anti-knock value, and other allied problems, are being always studied at the research laboratory at Yonkers, New York.

The last few years have seen, therefore, not only a large commercial extension of Ethyl gasoline, but a corresponding technical development, on the one hand helping the automotive engineer and the oil refiner to solve their mutual problems; on the other hand assuring the motorist that his gasoline shall not fall below certain definite standards of quality.



FLOAT-BOWL CARBURETER

Detail of double carbureter which enables shift from one gasoline to another quickly

A Memory Trick

At the Cost of An Hour's Intensive Study You May Learn a Mnemonic System Which Will Mystify and Entertain Your Friends. But Memory "Cures" Are Unscientific

By DAVID SPENCE HILL, Ph.D., LL.D.

Member American Psychological Association; late President Southern Society for Philosophy and Psychology; Fellow of the American Association for the Advancement of Science

UNUSUAL happenings like hypnosis, dreams, delirum, appeal invariably to the keen curiosity of human beings. When a charlatan or a "professor of memory" performs in public a seemingly impossible task, interest is quickly aroused. Thousands of persons, after witnessing such a feat, have paid considerable sums of money in order to learn how "to improve their memory."

The fact is, while persons of high intelligence may have excellent memory powers, nevertheless the ability to memorize certain things is not a general mark of intelligence. Cases are on record where imbeciles have been able to do amazing stunts of memory.

Attempts to invent devices to help defective memories have been frequent since ancient times. In comparatively modern times the Englishman, Pick, aroused excitement in England with his mnemonic systems. Some seventy-five years ago a man named Loisette, afterwards called an imposter, gained momentary respect and fame in Washington, D. C., because of his claim of inventing a valuable mnemonic system.

Everyone uses every day some kind of device to help to remember; for example, numbers on houses, monuments, trademarks. The success of advertising depends not only upon arousing attention but also upon creating lasting impressions. Most high school and college work depends upon successful memorization.

It is not surprising, therefore, that artificial, or formal, mnemonic devices continue to be sold to the unwary. By means of some of them seemingly, amazing things can be done by almost any person of fair intelligence who is willing to devote two or three hours to mastering such a system as the one explained herewith. This was devised by the writer and was built upon the following two psychological principles:

First, whatever we learn must be related to something we know already. This principle is technically called the "doctrine of apperception." Second, thoughts once vividly brought together in consciousness tend to persist. This is the principle of "association."

I. The first nine words of the system shown within the box begin with letters of the alphabet in numerical order. For example, A is No. 1 of alphabet (*Air*); B is No. 2, (*Bar*); C is No. 3 (*Car*) and so on. In the first nine mnemonics the final *R* has no particular significance.

1. Air	11. Ambrosia	21. Boa	31. Cocoa	41. Dahlia
2. Bar	12. Arab	22. Bib	32. Cub	42. Daub
3. Car	13. Arc	23. Boric	33. Comic	43. Diabetic
4. Deer	14. Almond	24. Bed	34. Card	44. Diamond
5. Ear	15. Ape	25. Bee	35. Cane	45. Dice
6. Fur	16. Aloof	26. Beef	36. Calf	46. Dwarf
7. Gar	17. Aching	27. Bug	37. Cog	47. Dog
8. Hair	18. Arch	28. Bunch	38. Cash	48. Dish
9. Indicator	19. Alkali	29. Biloxi	39. Cacti	49. Delphi
10. Acorn	20. Bun	30. Can	40. Dun	50. Emulsion

II. Final N always represents zero, including and after the tenth mnemonic. For example, 10th mnemonic is Acor*n*, 20th mnemonic is Bu*n*, 30th mnemonic is Ca*n*, 40th is Du*n*, 50th mnemonic is Emulsio*n*.

III. Including and after the tenth mnemonic, for the numerals, either the *initial* or *final* A always stands for 1, B for 2, C for 3, D for 4, E for 5, F for 6, G for 7, H for 8, I for 9, and N for zero. For example the 11th mnemonic is *A*mbrosia; the 20th is *Bun*; the 25th is *Bee*, and so on.

THE above facts make it easy to fix permanently in mind the whole list of mnemonics, each in its proper number or order. After accomplishing this, then picture with as vivid imagination as possible, what each mnemonic stands for. *Air*, picture, for example, a tank of compressed air; *Bar*, a big iron bar; *Car*, a railroad box-car; *Ear*, your own right ear, and so on through the list, making up your own list of associations. Make each mental picture definite and vivid. About one hour of undisturbed, concentrated study should be sufficient for you to fix in mind this list of mnemonics.

For a first experiment, or test, ask a friend to write and to number, say 25 or 30 names of simple objects, such as floor, tree, dog, clock, flower, house; that is, common nouns, only. Such words are easy to memorize after you have heard them read once, very slowly, with the number of each word spoken as it is read, and after you have pictured each word with a mnemonic in consecutive order.

When the first word has been read (say, "*floor*") immediately imagine strongly, some picture connecting *Air* (mnemonic No. 1) with floor. Perhaps you will visualize "an air tank in the middle of the floor." After definitely forming this mental picture, say "all right" as the signal for the second word to be spoken. Suppose the second word is "*dog*." Thereupon imagine vividly a dog being struck by an iron bar (Bar is mnemonic No. 2). Say "all right" again, and then call for the third word. Whatever it means to you is to be similarly associated with the third mnemonic (Car). This process is to be continued throughout the list.

Afterwards when recalling a word, first ask for its number. Suppose one says "Give number 2." This makes you think of *Bar* (see the table or "system") and *Bar* makes you think of *dog*. Thus you may repeat after one hearing a list of simple names of objects, in any order backward or forward.

To one who does not understand the use of this formal device the performance seems to be wonderful, but it is in reality no more wonderful than facts of every-day experience.

The ability thus acquired to repeat after one slow hearing, in any order requested, a list of simple words is quite startling to the uninitiated, and to be able to do the stunt is to have the means for a surprising amount of fun at a social gathering, or at dinner clubs. The performance, well done, invariably awakens interest.

To illustrate an important psychological principle and for amusement, this mnemonic device is valuable, but it can not increase native capacity, and the use of any formal mnemonic system is cumbersome and awkward in practical life. It is no cure-all for defective memory.

With the Historians of Science

Himera's Doric Temple Being Excavated

HIMERA on the north coast of Sicily is being excavated. The present excavations are being undertaken near the Doric Temple which was dedicated to Minerva. The government is helping by ordering the expropriation of the houses which cover the site. A number of broken columns have been unearthed as well as a great deal of the base, the facings for the walls, the architrave, frieze, and cornice.

Unearthing the History of the Crossroads of East and West

FRENCH archeologists in Syria have made important discoveries at what might be termed the crossroads of East and West on the Mediterranean coast near the old town of Latakieh. In a poor Alawit village a palace of 1300 B.C. was discovered. This is at approximately the period of the Exodus. A vast necropolis with princely tombs was also discovered. These tombs have been plundered, but enough remains to give indications of the religious rites of the builders. A library of tablets was also found which may indicate (when deciphered) the world's first alphabet. It will probably be some time before the experts can identify the letters with sufficient clarity to make up a language.

At Katna in the middle Syrian desert, other discoveries have been made. Three towns are built, on one another. In the second town the explorers found a temple to the Goddess Nin-Egal, "Lady Ef Katna," and an inscription identifying the town at Katna, one of the celebrated cities of antiquity. Count du Mesnil found two chapels where sacrifices were made to the bloody Goddess. In large basins of clay were traces of a brownish substance which was sent to Paris where police experts declared it to be bulls' blood at least 4000 years old. Vases and jars have been discovered containing skeletons of children.

Courtesy of the Oriental Institute

BRER RABBIT TRAPS THE LION

Exploits of the rabbit in an Arabic manuscript of the Thirteenth Century, showing the ending Uncle Remus describes

An Antecedent of Soap

THE ancients did not use soap, but removed dirt by "erasing." Fortunately we have examples of the scrapers as used by the Greeks and Romans, and now we have examples of the "bathing plaques" of Mesopotamia, 13 of which are in The Metropolitan Museum of Art. We should be inclined to call them "hide scrapers" and their application must have been anything but gentle, for the undecorated, or we should call it the "business" side, was roughened by adding small stone chips before firing. The plaques were probably executed by artist-sculptors rather than potters.

The conquest of Persia, Mesopotamia, Syria, and Asia Minor by the Seljykian Turks, nomads who came from Central Asia in the 11th Century, begins a new era of artistic development of the Mohammedan countries. These bath "stones" are assigned to a period between the 11th and 13th Centuries of the Christian Era.

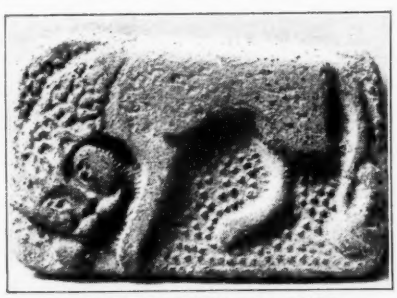
Ancient "Uncle Remus" Stories

THE Oriental Institute of Chicago is engaged in the investigation of an ancient work which, next to the Bible, has become the most widely distributed and translated book in the entire history of literature. This book is of particular interest to Americans, with whom the animal stories of Uncle Remus have become a household treasury. It is quite evident that this body of negro folk-lore contains fundamental elements which have migrated to America from the slave markets of Africa, having crossed the Dark Continent from the eastern to the western coast. Nothing has been easier than for tales of Arabia and even India to reach the east coast of Africa, and in this way they have eventually migrated to the plantations of our own South. Brer Rabbit thus emerges with an ancient oriental ancestry which probably few of our people have suspected.

These animal stories have also reached us by a northern route through England. In 1888 it was calculated that these animal tales had been translated "into 38 languages, in 112 different versions, which have passed into about 180 editions." These various versions are sometimes disguised under the title, the "Fables of Bidpai," or the "Fables of Pilpai." It is of no little interest that the illustrations which we already find embellishing the Egyptian animal tales, should also have been regarded as an essential part of the East Indian cycle. They are quite commonly found in the Arabic versions surviving at the present day, and here we may see Brer Rabbit over the discomfited Lion who is disclosed head downward at the bottom of the well in precisely the same uncomfortable situation into which Uncle Remus tells us Brer Rabbit betrayed him.

MOHAMMEDAN BATHING PLAQUE

An animal group on the decorated side. The reverse was roughened by adding stone chips before the plaque was fired



A LION BATHING PLAQUE

This is supposed to illustrate a lion and dates from the Eleventh to the Thirteenth Centuries of the Christian Era

THE AFFRONTED BIRDS

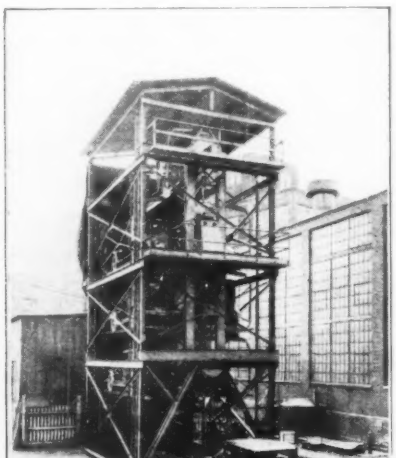
A highly artistic piece from Mesopotamia, modern in treatment. This was found in a public bath where it was originally used

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

A "Ferris Wheel" Car Parking Machine

WE have become so accustomed to automatic devices that we expect the pushing of a button to give us any desired result. In our own homes we press a button to turn on the lights or to start a fan.



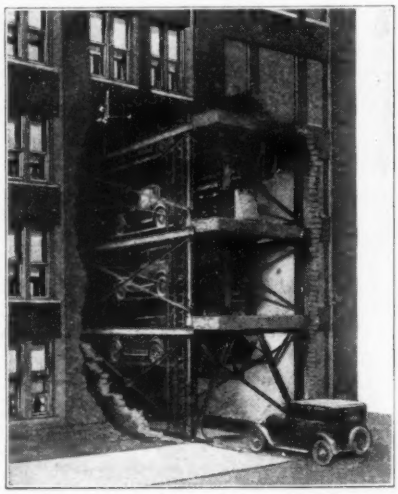
The experimental car parking machine developed by Westinghouse

If there is an elevator in the building, we call the car to the landing by operating a button. The immense presses printing our newspapers and magazines are controlled by push buttons, as are many other machines in daily use. It will, therefore, seem reasonable to have a parking place for our automobile where we can call the car to the driveway level by pushing a button.

This has recently been accomplished by the design of an automatic parking machine, resembling an elongated Ferris wheel, which can be installed in hotels, apartment houses, theaters, department stores, and office buildings as well as in garages. The cars are placed on platform cages suspended between endless chains which pass over wheels at the top and bottom of the building. The chains are operated by an electric motor provided with a push-button controller which will stop the machine when the designated cage is opposite the driveway. When a car is driven on a cage, automatic means are provided for moving another empty cage to the driveway so that the machine is always ready to receive another car. The cars remain on the machine until called for.

The part of the building in which the machine is located has no floors and may be merely an enclosure surrounding the machine or it may be a portion of a building used for other purposes. The machine may be removed at any time and floors placed in the building for other uses. The operation of the machine is quiet so that the ordinary separation walls that would be provided in the building will prevent the sound from being carried through the building. After the machine has been started, its motion is continuous until the specified car has reached the driveway.

A very ingenious arrangement is used to transfer the cars from one side to the other at the top and bottom of the building. This consists in carrying the car on an arm that extends from the side of the chain. During the vertical motion the cage and chain travel at the same speed but at each end of travel, the car moves in a circle having a radius of about double that of the chain. This causes the car to travel at twice the speed of the chain and moves it out of the way of the next car. The arrangement enables ordinary passenger cars to be placed eight feet apart in the vertical position. A building 100 feet high will provide for a 24-car machine which occupies a ground area of approximately 16 feet by 24 feet; this is about the same space that is occupied by an ordinary two-car garage. There is no particular limit to the vertical height of the machine as this will usually be determined by the building limitations and also by the time required to bring the car from the top of the building to the



Manner in which the car parking machine is built into a building

driveway level. The machines which have been constructed have had a chain speed of 100 feet per minute which would bring the car from the top to the bottom of a 100-foot building in one minute. Higher speeds can be used where the conditions make it desirable to do so.

Giant Hog Was Big as Auto

THE fossil skeleton of a giant hog which stood seven feet tall has just been mounted in Morrell Hall at the University of Nebraska. The terrible pig in his prehistoric day was as high as the tallest modern automobile and had a "wheel base" of about 140 inches.

The fossil was dug up in Sioux County, Nebraska. Only two of the giants have ever been discovered, the other being smaller than the university's specimen. The pig, scientifically termed *Dinohyus hollandi*, lived during the late Oligocene or the early Miocene age, which would give him an antiquity of some 12,000,000 years.—*Science Service.*

Cape-to-Cairo Highway Improved

IN the article "Pioneering for a Cape-to-Cairo Highway" which was published in our August issue, the author, Mr. Gerry Bouwer, made the statement that, "northward from Bulawayo there was nothing but dense African forest with only native paths for a road . . ." Mr. E. J. Hutton-Brown, Superintendent of the Southern Rhodesia Publicity Bureau, apprehensive lest this statement deter tourists who contemplate a visit to Southern Rhodesia by road, calls attention to the fact that the highway has been considerably improved since Mr. Bouwer's trips. To prevent any misconception as to the present state of the highway in question, we publish below a part of Mr. Hutton-Brown's letter:

"For the past 12 months the road from the Transvaal border, that is, from the ford through the Limpopo River to the Victoria Falls via Bulawayo, has been clearly defined and maintained in good order by the Southern Rhodesia Roads Department. The road has been widened out from the original track, and made up wherever bad places occurred. Signposts have been erected at all important deviations, and, when it is stated that approximately 10,000 automobiles used this road for pleasure purposes during the past season, it will be realized that the pristine conditions of which Mr. Bouwer wrote, no longer exist.

"A tour by road to the Victoria Falls during the correct season, that is, from May 1 to September 30, has become deservedly popular with every visitor to

Car parking tower, an independent invention which is operated on practically the same principle as the one described and illustrated above. It was invented by Mr. J. E. Morton of Sandusky, Ohio

South Africa from overseas, and visitors do not consider their arrangements are complete unless they include this wonderful trip through some of the most magnificent of Southern Rhodesia's forest scenery. Furthermore, since Mr. Bouwer passed through, the Victoria Falls Hotel, situated on the edge of nature's most mighty masterpiece, has been renovated and enlarged, and now provides accommodation and attention for travelers which is amazing, considering its far-flung position.

"At the beginning of the month of August an ornate high level road and railway bridge, over 1500 feet in length, spanning the Limpopo River, was opened for . . . tourists traffic, so that there is no longer any necessity for automobiles to be towed across the river as is depicted in the photograph accompanying Mr. Bouwer's article."

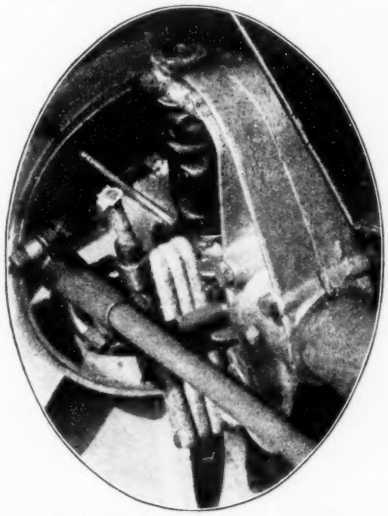
"Baby" Car for United States Market

IT has been announced that within the next year a small automobile seating two people comfortably, weighing 600 pounds, and equipped with a four-cylinder air-cooled engine, and with all moving parts, except the engine, greased for the life of the car, will appear on the market in the United States. The car has been designed in its entirety by James V. Martin of Garden City, Long Island, who is well known in the aviation field; in fact the car itself is an outgrowth of Mr. Martin's experimental work in aviation.

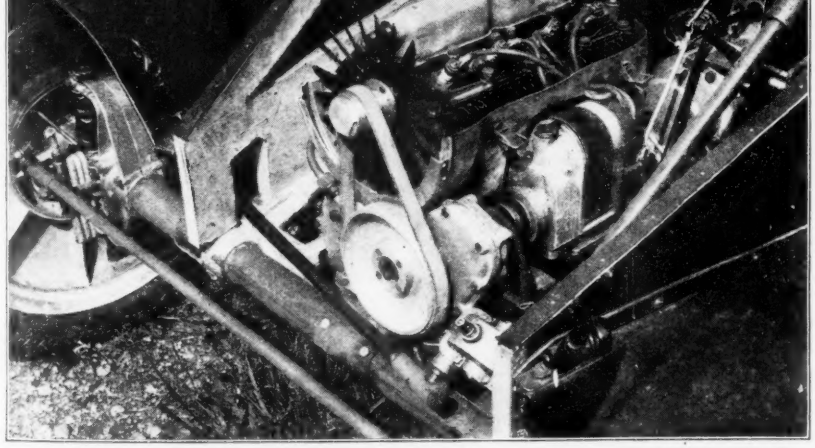
The photographs give some idea of the construction of this tiny car which has no chassis, the body frame serving as the support for the suspension for the front and rear ends. There are no springs, the wheels being separately suspended by means of rubber shock-absorber cords such as are employed in many types of airplanes. This suspension allows each wheel to work independently of the other three and reduces the "unsprung" weight to a minimum. It is claimed that these shock-absorber cords will function perfectly for 25,000 miles of operation and that they can be replaced by anyone quickly and at a very low cost.

In the rear end there is a universal joint on each side of the differential and another in each wheel. Because of this construction, power can be transmitted directly to the wheels without any axle housing. The wheels are suspended with the shock-absorber cord and work independently of any other part of the car; in fact the differential is fastened rigidly to the underpart of the body.

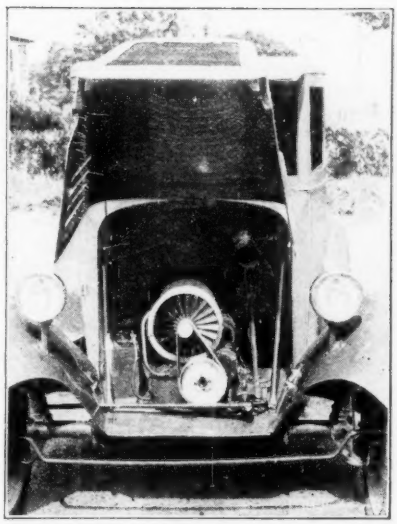
This little car has a wheel-base of only 60 inches and uses small rubber tires, yet in a demonstration given to the writer of this item, the car held the road perfectly at 60 miles per hour and was as comfortable as a much larger and heavier car. During the demonstration, the automobile was driven over a rough plowed field with an absolute absence of the racking rebound which would be found under the same conditions with a car suspended by ordinary springs.



Detail of the airplane shock-absorber cord mounting of a wheel of the "baby" car. The wheel spindle rides on a vertical shaft enclosed in a leather dust protector. The entire weight of the car rests on the rubber cord, being suspended from the wheel spindle



A view of one of the experimental models of the "baby" car, with the hood raised, showing the motor with the air-current-directing cowl removed to show the fan and the cylinder heads. At the extreme left of the photograph may be seen one of the separately suspended wheels shown in detail above



Front view of small car with cowl in place on the air-cooled motor

It is intended to sell this small car at about 200 dollars including a large waterproof packing case which may be used as a garage for housing the car. At the present time, however, plans for production have not matured and it is impossible to state when these small cars will be available to the general public.

The present plans and specifications call for an electric starter or a mechanical starter operated by foot pressure, a gasoline tank mounted under the cowl, a standard 3-speed and reverse selective gear shift, a 4-cylinder air-cooled motor equipped with a large fan, disk wheels of new ribbed construction, and a two-passenger body in which there is more than ample leg room for both driver and passenger.

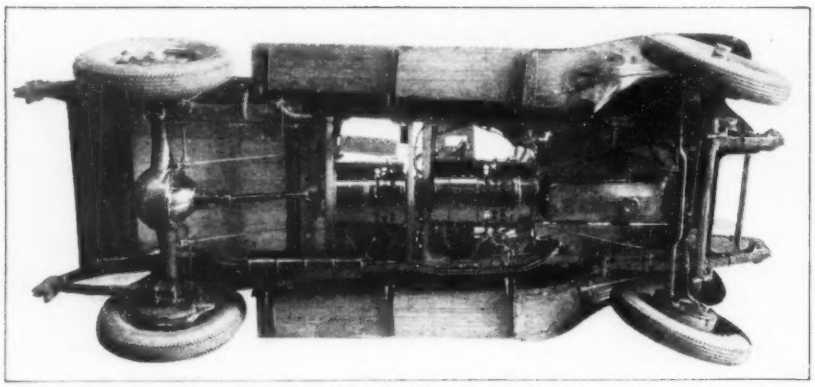
Japanese Navy Correction

IN Dr. Oscar Parkes' illuminating discussion of the newly built ships of the Japanese navy appearing in our November, 1929, issue, a typographical error occured in giving the dimensions of the cruiser *Nachi*. She was quoted as having a draft of 86½ feet whereas this should have been 16½ feet. Please make this correction in your file copy of the issue.

A High-Speed Gasoline-Electric Automobile

A NEW type pleasure automobile with no clutch or gears to shift, and capable of quick pick up and fast speed on the hills—a combination 60 horsepower gasoline and electric car—has been delivered to Colonel E. H. R. Green, son of the late Hetty Green, world's richest woman, at his South Dartmouth, Massachusetts, estate. It is the first automobile of its kind ever built, and is the result of combined experimental work by engineers of the General Electric Company and the Rauch and Lang Corporation of Massachusetts.

In external appearances it looks just like any gasoline driven car, except for a windshield double the average height. This was made especially for Colonel Green so that when the top is raised he may get in and out of the car without stooping over. The real difference is in the mechanism under the floor boards and in the controls. There



View underneath a Willys-Knight chassis equipped with electric drive. The generator is directly behind the engine and the motor behind the generator

are but two foot pedals, one for the brake and one for the gas. The clutch pedal and the gear-shift rod, or lever, to the right of the driver in ordinary cars, are eliminated. The emergency brake to the left of the driver and the starting button to the far right are the same as in other cars.

In addition to the absence of the clutch and gear shift, other features of the new car are that it is impossible to stall the engine without actually shutting off the ignition and it is impossible to start with a jerk. Even though the accelerator pedal is jammed down to the floor board, the pick-up will be gradual and smooth because of the automatic electric equipment. There is also an outstanding safety feature, for the driver can keep both hands on the wheel and his eyes on the road at all times after the car has once started to move. When the car is brought to a stop, the idling of the gas engine is not sufficient to cause the generator to generate enough electricity to turn the motor. All that is required to get the car under way again is to remove the foot from the brake pedal and step on the gas. The more gas, the faster the speed.

This particular car for Colonel Green is geared to make 40 miles an hour. However, by changing the gear ratio on the rear axle, it can be made to operate at speeds comparable with gas driven cars, according to engineers of the General Electric Company.

The electric generator is mounted directly on the fly wheel housing of the gas engine, the generator armature revolving at exactly the same speed as the engine. A few inches back on the generator, or approximately under the front seat, is the electric motor, connected by cable to the generator and coupled by a short drive shaft to the rear axle. As the generator is speeded up, more electricity is fed to the motor, and as the motor picks up, so does the speed of the car. To reverse the car, a small lever is moved, reversing the operation of the motor.

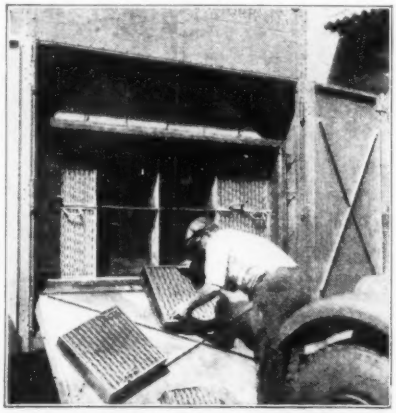
As the motor operates at high speed, the gear ratio on the rear axle was made a worm drive of from 8¼ to 1, instead of the standard $4\frac{7}{16}$ to 1 gear reduction for cars of this type.

On its arrival at Round Hill, his South Dartmouth estate, Colonel Green insisted on taking the steering wheel himself and for the first time in his life, drove a gasoline operated automobile. Although he now has 25 cars of various types and makes, he has never been able to manipulate the clutch pedal and gear shift and heretofore has used a small electric storage-battery car in his daily drives about his estate.

Colonel Green has ordered a second car of this type with a limousine body and is planning a third, of the touring car type in which the driver will occupy an elevated seat in the rear, for use at his Miami, Florida, winter estate.

Truck Removes Cellar Ashes Pneumatically

THE cellar ash-can is facing extermination. Ashes can now be removed expeditiously and economically, with a minimum of labor and with no diffusion of dust, by an electric-pneumatic suction system through a pipe-line from sidewalk to ash-pit.



Ventilating fan and sectional air filter screens of the pneumatic ash conveyor system for trucks

The equipment comprises an ash-handling truck containing a large hopper into which the ashes are drawn by suction, and from which they are conveyed by a totally enclosed belt-conveyor to a carrier-truck which takes them away.

The ash-handling truck is equipped with the gas-electric drive now in wide use for heavier vehicles and already introduced for automobiles of the ordinary type. Power for operating the suction system and the conveyor-belt is obtained by connecting the electric generator to the proper motor and running the engine at suitable speed while the truck is parked.

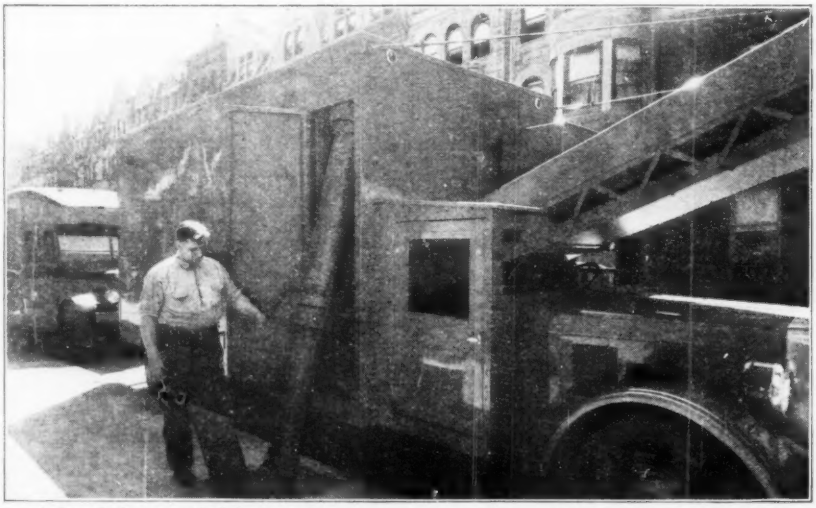
The first of these new ash-handling trucks has been put in service in New York City by the Pneumatic Conveyors Corporation. It was designed and built by the American Car and Foundry Motors Company, and was electrically equipped by the General Electric Company.

Suction is provided by a centrifugal compressor, rated at 6000 cubic feet per minute at a speed of 3500 revolutions per minute and driven by a 40-horsepower motor. The truck is equipped with piping capacity permitting a suction of 2800 cubic feet per minute, equivalent to a velocity of 145 feet per second in the intake pipe. This means that ashes equivalent to the contents of a dozen standard ash-cans can be drawn up every minute to a distance of 30 feet.

Later there will be undertaken the design of a smaller unit, provided with a flexible pipe-line, which can be used for removing ashes from the cellars of residences. The present unit, intended for large buildings, is equipped with a permanent rigid pipe-line extending from sidewalk to ash-pit.

The conveyor truck connects to this pipe-line at the sidewalk opening by means of a pipe section attached to the truck and connecting to the hopper. This pipe section is lowered into place and tightly connected at the sidewalk with the permanent pipe-line so that no dust escapes to the outside air at any point.

In addition to the removal of ashes from cellars, the pneumatic conveyor truck can function with efficiency and economy in unloading coal barges. In that field of application it is expected the truck will prove as useful in proportion as in the elimination of ash-can handling and dust-



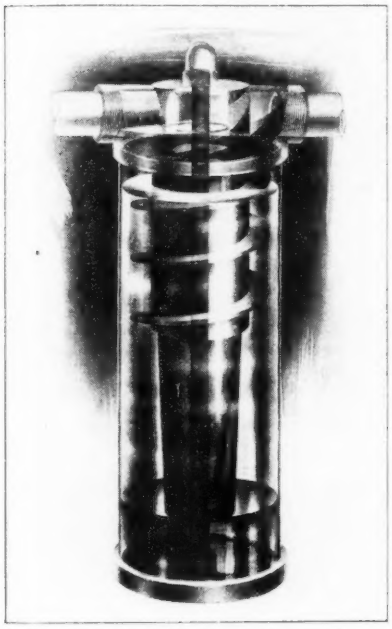
Ashes being carried from a basement to an ash truck by suction. Over the driver's seat is the conveyor which transfers ashes into a dumping truck

filled air which are now aggravating accompaniments of the removal of ashes from cellars in cities and towns.

Centrifugal Separator of Water and Gasoline

WHEN you buzz along the road in your car and water gets into the carburetor—you coast along and stop. But when water gets into the gas of an airplane, the plane is apt to stop quickly—meaning a forced landing or, as sometimes happens, a serious crack-up.

To assure water-free gas, every Bowser aviation fueling pit is equipped with a



The device that separates water from gasoline by a swirling action

centrifugal water separator like that illustrated. Gasoline flowing into it is forcefully swirled and the water, being heavier than the gasoline, is thrown to the outside and trapped in the water chamber, which can be emptied periodically. The action is similar to that used in cream separators for separating cream from milk. As a further protection, the storage tanks of Bowser systems may be equipped with a float-suction which removes the topmost liquid first, and all are equipped with several fine-mesh strainers for removing sediment and dirt from the gasoline.

Unbreakable Truck Tail-light

INVESTIGATION has shown that truck fleet owners as a rule do not know how much the tail-light problem costs them a year because it is not generally accounted for under one heading. But if those who do not know will add up the costs of tail lamps, material, time lost on lamp replacements, time lost on summonses, liability damage suits due to no tail-light, for a single year, they will find the total is much greater than it should be.

Many of these vehicles resort to the old barn lantern for a tail light. The barn lantern detracts from the appearance of any modern vehicle, is a makeshift, is a considerable fire risk, and as most users know is easily broken.

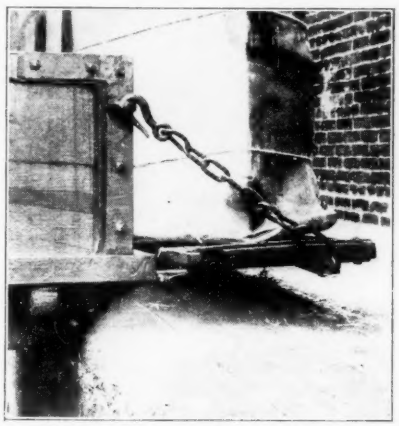
A new unbreakable tail-light called the Bull lamp, and manufactured by the Champion Rubber Lamp Company of New York City, is made especially for trucks, commercial vehicles, trailers and tractors. These vehicles find it impossible to keep the ordinary pleasure-car tail lamp in commission, due to collision, impact, and vibration.

The Bull lamp is made entirely of rubber, the lens of a special unbreakable compound, and the electric bulb is suspended and protected so that vibration does not affect it. The lamp and fittings are rugged and when properly attached to a vehicle cannot be sheared off. It is easily and quickly attached to any vehicle.

Hydraulic Shock Absorber Installed at an Angle

THE ups and downs of automobiling are not the only jouncing discomforts that a motorist experiences. Starting jerks—braking—sudden stops—sideway lurching—these also exist.

For six years past, a radically simplified type of shock-control device has been going through its test paces. Conceived by a staff of engineers who recognized the magnitude of the problem, this new-type shock absorber was subjected to many tests—laboratory tests far exaggerating the conditions of the road—and tests on the road that attempted to break down the laboratory result. It has been placed on the market under the name of Hydraulicator.

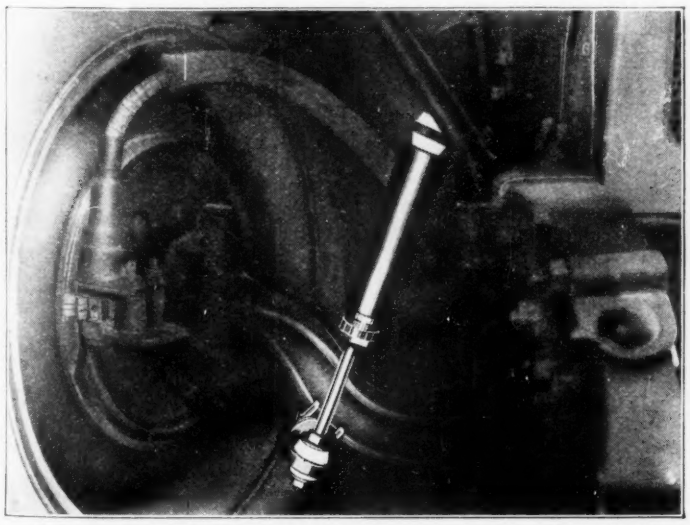


The truck rear-end bumps into a platform but tail light is unharmed

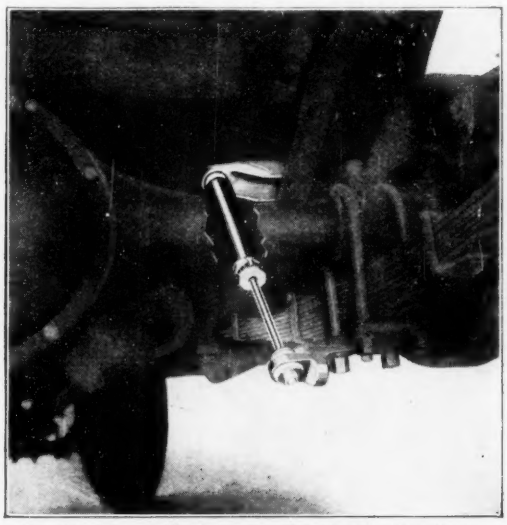
In distinct variance to all former methods of installation, the Hydraulicator is not installed in true vertical position. The rear axle units are inclined forward; the front axle units inward—a revolutionary method of installation that provides efficient, all-angle shock control.

Angular installation eliminates "shimmy." In tests on a well-known car that "shimmied" excessively at only 25 miles per hour, the angular installation of Hydraulicators eliminated the condition entirely, even at excessive speeds for a car of this light type and short wheel-base. Hydraulicators are claimed to prevent "bottoming" of the springs. The new shock absorber cushions the shock in a full half-pint of fluid, every drop of which is in constant, active use.

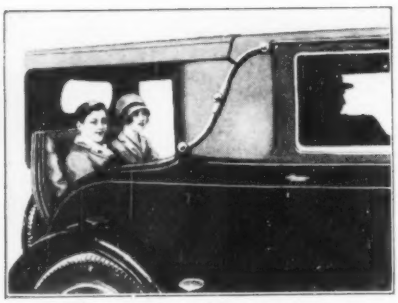
The Hydraulicator is a simple unit of cylinder and piston. The piston is provided with ports or by-passes to permit the passage of the piston through the fluid. When the unit is mounted between the chassis frame and axle of a car, the resistance created by the passage of the fluid through



The hydraulic shock absorber is mounted at an angle to both the vertical and horizontal, on the front axle beam of a car



On the rear end of a car, the shock absorber takes angles different from those on front



The new rumble seat cover

the ports is proportioned to control the spring action to any desired degree.

Although the unit is a two-way device, the resistance offered is not the same on the up, or compression stroke of the spring, as on the down, or recoil stroke. On the compression stroke a comparatively small amount of check is provided, just enough to prevent the spring from compressing too quickly and "bottoming" on the frame. On the other hand, in order to get riding comfort, the rebound stroke is retarded to the point where the shock is absorbed.

Instead of the customary valves, springs, tubes, et cetera, the piston assembly of the unit is composed of three parts: a piston, a flat steel check washer, and a flanged sleeve. The piston moves or "floats" on the sleeve. On the compression stroke, the pressure of the fluid forces the piston down against the flange of the sleeve, shutting off a predetermined portion of the piston ports. On the rebound, the piston is forced up against the check washer, shutting off a greater portion of the ports, and creating a correspondingly greater amount of check.

A Cover for the Rumble Seat

THERE has long been a demand for a practical top for automobile rumble seats. One recently placed on the market fits any roadster or sports coupé. It can be put up or removed in a few minutes without the aid of tools, and anyone can install it. It affords protection from rain, snow, sleet, wind, or cold, and makes the rumble seat comfortable when the rays of the sun are merciless. "Rumbletop," as the new detachable top is called, can be folded into its small container and stored in a corner of the car when not needed. It can be quickly set up as soon as the weather threatens. There are no screws or bolts to drive into the body.

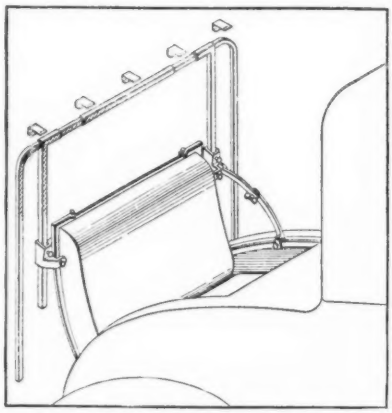
Side curtains are available, if desired, thus affording complete protection against cold weather. The occupants of the rumble seat can get in and out when the top is in place. A pull on the "zipper" underneath the top folds it back, making entrance or exit very convenient.

"Stop-Go" Lights Operated by Car Passing Over Pavement

A MECHANICAL device to direct the movement of traffic in exactly the same manner that a human being would direct it—a device with mechanical senses equivalent to human eyes and a mechanical brain capable of "thinking," "remembering," and of giving orders—has been perfected by the Automatic Signal Corporation of New Haven, Connecticut.

Perhaps the fundamental difference between the corporation's Electro-matic system and the stop-and-go light systems now in use may best be shown by a comparison of the two with the traffic policeman. In every respect the present stop-and-go lights are similar to a traffic policeman sent on duty at an intersection, but blindfolded and with instructions to count 30 seconds on one street and then to turn and count 30 seconds on the other streets, constantly and without regard for the flow of traffic. Even though a dozen cars may be waiting on one street and none on the cross street, the blindfolded policeman will still continue to count 30 seconds before permitting the waiting cars to move.

Installation of the Electro-matic system is the equivalent to the removal of the blindfold. The policeman never keeps a line of cars waiting when there is no cross



Framework and clips which hold the rumble seat cover in place

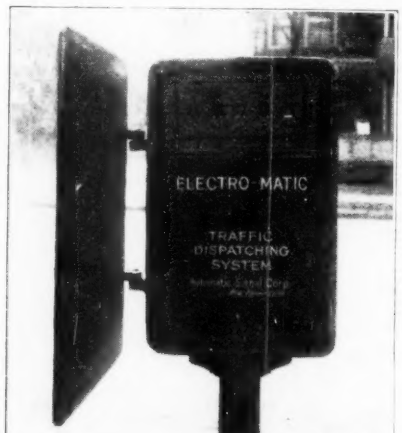
traffic. He signals them to move ahead just as soon as the intersection is clear. He cares for the safety of every vehicle, but also avoids all unnecessary delay.

With the Electro-matic system, long lines of vehicles receive a continuous right of way. They are never stopped as they are under present automatic systems unless cross traffic actually appears. When opposing traffic does approach, the Electro-matic system waits for a break in the line before turning the signal to the cross street. If no break occurs, it waits for a maximum period of time and then stops the line while the cross street vehicles pass. In any case, however, the long line is never kept waiting unnecessarily. At the instant the cross traffic has cleared, whether it consists of one or a dozen cars, the device "remembers" the waiting line and turns to signal it ahead again.

The system consists of three main parts, the most important of which is the control, or "brain" of the system. This is housed in a heavy metal box and is located on one corner of the intersection. Like the human brain, the mechanical brain must have eyes, the second important part of the system. The "eyes" of the Electro-matic system are electrical pressure contacts. These are sunk into the pavement on all streets approaching the intersection, their distance from the corner depending upon the characteristics of the traffic flow at the particular crossing. The third important part is the signal itself, which may be any type of light or signal now in use.

When vehicles pass over the pavement pressure contacts, electrical impulses are flashed over underground cables to the control box. The control then operates the light to meet the exact demands of traffic at the particular moment. The control, however, is capable of more than "seeing" everything that approaches on all sides of it. It is capable of "thinking" and "remembering." Overhead units of a similar type are provided for street cars, and neither snow, rain or ice interfere with their operation.

All of the controls at intersections in the central district of a city may be linked together into a co-ordinated system so that traffic throughout the central area may be moved as expeditiously as it is through a



The street corner control box of the new automatic traffic control

Automobiles passing over the pavement installation outlined in foreground "notify" the control, in center background, which operates lights at right

single intersection. When the controls are co-ordinated in this manner, it is possible for traffic on the main arteries to move continuously and uninterrupted by red lights the entire length of the street, regardless of speed. Once past the first light, moving in either direction, vehicles would be able to move without stopping during the entire length of the co-ordinated system. Their speed would not matter. The Electro-matic system is the only one which may be co-ordinated so that traffic will not be forced to move at a fixed rate of speed in order to avoid stops.

Under co-ordination, the controls keep in constant "communication" with each other. The controls at the key intersection at both ends of the main artery telegraph ahead to the next controls the exact number of cars in each block of cars. When the first car in the block reaches the next pavement unit, the light immediately turns green and remains green until the last car has passed. It then turns behind the last car to accommodate cross traffic. This continues until each block of vehicles has passed undelayed.

The controls are exceedingly flexible and are adaptable to any kind of an intersection and to any kind of traffic. They will care for highway traffic as efficiently as city traffic and can be used with equal efficiency at intersections of several streets.

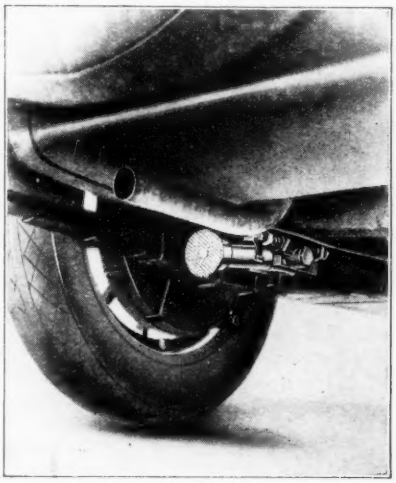
Hydraulic Jacks Installed on Car

DURING the evolution of the automobile from the "one-lunger" of 1900 to the present time, there have been radical improvements in every part of the car with the exception of the method of jacking up the wheels. While automobile jacks have gone through a minor process of refinement, it was not until recently that there was a way to jack up a car without the use of a portable jack.

The development of the Superior four-wheel hydraulic jack provides the first practical method of building into a car a permanent mechanism for raising the wheels. It consists of a set of four hydraulically operated jacks, one for each wheel, to be attached to the axles of the car. The operation of the jacks is controlled from the dash board of the car and each wheel may be raised independently of the others, power for the pumping operation being taken from the engine. The pumping mechanism controls both the raising and the lowering of the jacks. When the jacks are not in operation, they are automatically fastened out of the way and cannot be lowered unless pressure is applied.

The Superior four-wheel hydraulic jack is not affected by the condition of the road or pavement. The swivel base adapts itself to any angle or surface. The jack is positive in action and will not slip or shift.

The new hydraulic jack can be installed as part of the permanent equipment on pleasure cars, buses, and delivery cars.



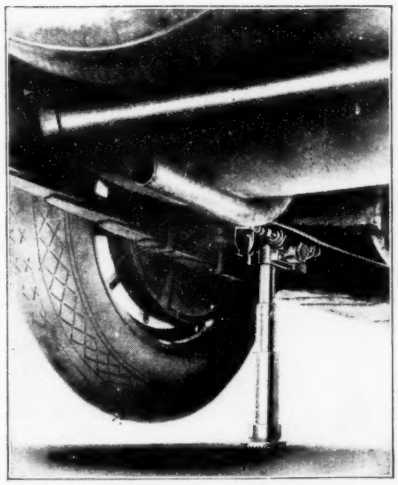
The permanently installed jack as it is clamped when not in use

New Type Differential Stops "Spinning Wheel" Evil

A NEW type differential, called the Krohn differential, is said to proportion the engine power to the wheel that can use it and stop the "spinning wheel" evil. It is manufactured by the Krohn Differential Corporation, 209 South La Salle Street, Chicago.

While the device is new to most car owners, many truck operators, and engineers, it is not new in service. It has been successfully used since 1924 and has been quietly distributed to fleet owners who were having trouble making rear-ends stand up in particularly arduous service. This differential, like the conventional type that has been used for years, permits one wheel to turn faster than its mate when rounding a corner. It lets one wheel turn if that wheel is jacked up, but it does not allow one wheel to spin idly, robbing the other of power, when driving on wet paved roads, through mud, or over roads that are slippery with snow and ice.

From time to time various specially designed differentials have made their appearance, but these have usually been locking types or intricate mechanisms having more disadvantages than advantages. This new one does not lock. It does not compel the wheels to turn at the same rate of speed, nor is it at all complicated. And while it permits a wheel that is jacked up to turn freely, it utilizes the slightest retardation—even the friction of rubber on wet ice, and employs this resistance to direct the engine power to the wheel having traction.

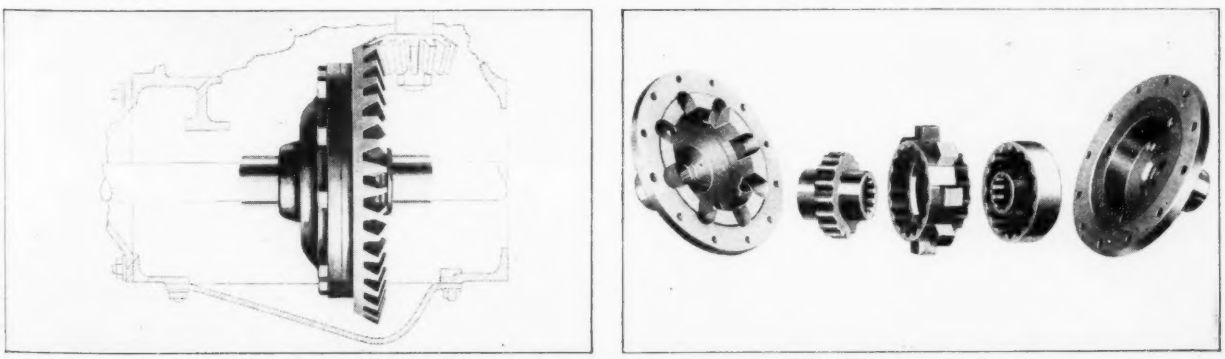


Hydraulic jack in raised position

The three simple working parts of the Krohn differential are shown in the central part of the illustration. The two halves of the case are at the right and left. A ring gear is mounted on the case, just as with any differential, and the rotation of the case is imparted to the central gear. This, in turn, transmits rotation to the other two gears which are splined on the two drive shafts.

The differential action is obtained, when traction varies, by a difference in the number of teeth in the various gears, which permits the central gear to rotate about the other gears. This allows slight rotation of one driving wheel with respect to the other which is necessary when rounding corners. It does not, however, allow complete freedom of rotation of either driving wheel with respect to the other. And it is this fact which prevents wheel spinning and insures getting power to the wheel that has traction.

In operating a truck, tractor, bus, or pleasure car, this action becomes automatic. The slightest tendency to slip is handled by the Krohn differential before it causes actual slipping. The flow of power is thus constantly directed to the wheel that can use it and the truck becomes seemingly more powerful, shows greater gasoline mileage, and goes up slippery hills and over stretches of ice or snow that could formerly be negotiated only with great difficulty, even with the help of skid chains.



The new differential and its various elements, as described in the text

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

A New Boundary Light

IT is extraordinary how our systems of airport lighting have developed in the last few years, from the primitive methods first used by Army aviators of soaking rags in gasoline and burning them as guides to the incoming pilot. We have now route beacons which guide the pilot to the airport; obstruction lights which mark such

Boundary light in working position

hazards as hangars; flood-lights of immense power which illuminate the entire landing area; and finally boundary lights which mark the contour of the field.

The boundary lights, while quite indispensable, offer an element of danger since they must be mounted about ten feet or so above the ground, and may be struck by the plane's undercarriage with disastrous results. The Curtiss-Wright Flying Service is responsible for the construction of a new type of boundary light which avoids this danger.

As shown in our photographs, the new boundary light is supported by a cone which is held in place solely by its own weight. If struck, is overturns easily and disconnects the wiring by pulling a plug through a flexible cable from a weather-proof cut-out. Breaking the contact cuts out one light without affecting other lights on the system. This is a decided improvement over the old system of iron pipe standards.

The Problem of Air-Sickness

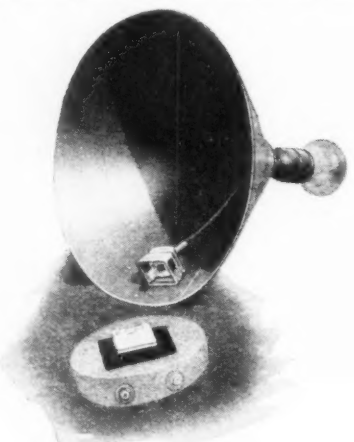
AIR-SICKNESS can be just as unpleasant as sea-sickness and its elimination is a most important problem in air transport.

The Daniel Guggenheim Fund for the Promotion of Aeronautics has therefore done a very useful piece of work by conducting an international inquiry into the subject, consulting American, British, French, German, and Italian authorities, and publishing a survey under the above title, copies of which will be supplied gratis upon application to the offices of the Fund at 598 Madison Avenue, New York City.

There seems to be no doubt that sea-sickness or air-sickness is primarily due to the action of accelerated motion on the labyrinth of the ear, although the exact phenomenon is not yet clearly understood.

There are, however, many contributing causes. One is psychical. A nervous person, expecting to be air-sick, is certain to have his expectation gratified in rough air. The remedy is distraction of the passenger by the provision of interesting instruments in the cabin, maps of the country passed over, et cetera. In the installation of equipment and furnishings in the cabin, attention should not be directed to the possibility of air-sickness. The mere provision of a special receptacle in full view of the passenger may cause his mind to dwell on the possibility of air-sickness, with unpleasant consequences.

Another contributing cause is visual. The airplane should be flown at a fair height, say 2000 feet or more. At such a



New light overturned when struck

height a wide view of the landscape is obtained, and there exists a lessened appreciation of the relative movement of the earth and the horizon. Besides, at heights there is always less bumpiness of the air. The passenger should also have a clear and unobstructed view of the horizon, with no window bars, struts or wings in close proximity to the eye. A high-wing monoplane with ample window space is recommended by a British medical officer

Lack of ventilation always results in air-sickness, but noise is also a contributory cause. Opening the windows wide will give a passenger plenty of fresh air, but will also increase the noise and there is thus a serious conflict in requirements. Designers should strive to place the engines as far as possible from the cabin. Special ear defenders are helpful. But perhaps the most important protective measure is the provision of purely artificial ventilation, in which the opening of windows is entirely dispensed with.

Are medicines helpful? Giddiness cannot be fought by drugs, but the "vegetative effects" by which German doctors politely designate nausea can be checked partially by such European preparations as those termed "Vasano," "Nautisan," et cetera.

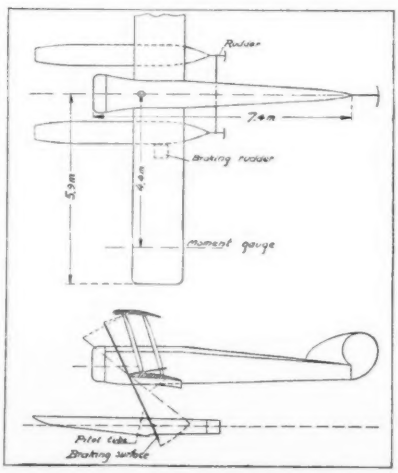
The North German Lloyd employs a further method, known as the Dammert inhalation method. No tablets or powders are involved in this, the medicaments employed being inhaled through a tubular apparatus in a dry and finely diffused state. This is effected by wearing a mask for a period of five to ten minutes. Used on all the North German Lloyd's steamers, this treatment has proved fairly successful. It is not unpleasant and is perfectly harmless.

Problems of Winter Flying

WE understand that it is not uncommon in Sweden for an automobile to be driven out over the ice to a vessel moored in a harbor. Cases are reported of airplanes taking off and landing on frozen waters. Evidently the Swedish aviators also have many winter problems on their hands. One of them is the starting of aircraft engines at low temperatures.

An intensive study of fuels and oils has apparently determined that it is impossible to start an engine at very low temperatures without warming up the engine. With a water-cooled engine a blow lamp applied to the cooling water seems to work out very well. In the air-cooled engine the difficulty is greater. The only practical solution appears to be to warm up the whole engine, a far more difficult job than warming the cooling water only.

With float seaplanes used in Sweden, there arises the problem of being able to land indifferently on water or on snow and



Water rudder and braking rudder used in restricted Swedish waters

ice. It is possible to land on snow or ice with ordinary floats, but the wear and tear are prohibitive. The Swedish engineers are experimenting with floats which are elastically mounted and which have elastic bottoms.

While constructors have given much attention to the braking of wheels, they have apparently taken for granted that seaplanes would always have plenty of space to land in. In the narrow Swedish rivers maneuverability becomes more important. Accordingly, water rudders are employed and also braking rudders on the sides of the float. A typical arrangement is shown in our diagrams, by courtesy of the *Royal Aeronautical Society Journal*.

Tailless Light Planes

WE have just received some photographs of low-powered, tailless German planes, which are evidently derivatives of glider practice. While little technical detail is available, these photographs deserve careful study.

The first illustrations show a small two seater, built by Espenlaub, the famous German glider pilot. This plane is equipped with an opposed two-cylinder Bristol Cherub of approximately 20 horsepower, and is provided with a three-wheel landing gear. The main departure from conventional practice lies in the lack of fuselage and tail surfaces

How then is control achieved? The reader will note that the wings have a pronounced sweep-back from their point of attachment at the fuselage. At the tips of the wings there are apparently two hinged rear surfaces on each side. Evidently one pair of these hinged surfaces will act as the conventional ailerons. The other pair, being far back of the center of gravity owing to the sweep-back, will exercise a longitudinal moment about the center of gravity and will act like an elevator. We have therefore both lateral and longitudinal control. Probably also the wing itself has some degree of reverse curvature so as to give fair longitudinal stability while the pronounced sweep-back gives large lateral stability. Apparently the rudder is dispensed with.

In contrast with the conventional airplane, there are, therefore, only two controls instead of three. This involves a novel method of piloting on turns. The pilot banks for a turn with his ailerons, the machine side-slips in the direction of the turn, and the inherent stability of the machine swings it in the right direction and prevents excessive banking. It is plausible to say that the controls have been simplified by the use of only two controls. On the other hand, the control is not so positive as when the three-control system is available. We believe that a greater degree of skill will be necessary with this type than with the conventional plane. On the other hand there are some real advantages.

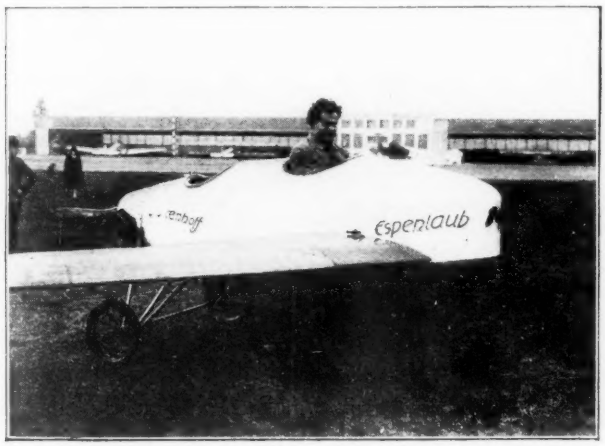
First of all, owing to the absence of the fuselage, there is a decrease in weight and head resistance. Also the cost of the machine is decreased. The use of a three-wheel landing gear is a safeguard against turning over. Therefore, the type has some possibilities for the small sport plane, particularly if a rudder system is added.

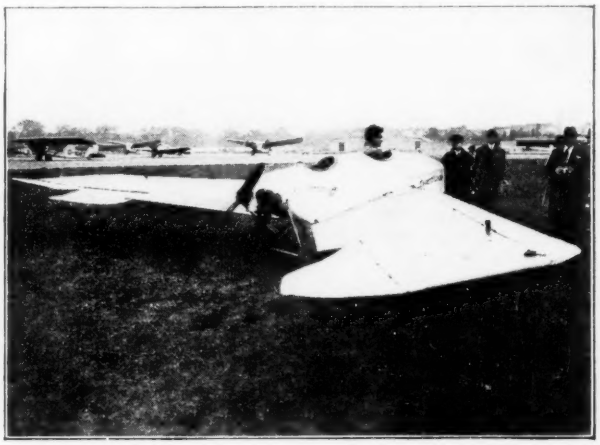
Another tailless light plane is built by the Rhön-Rossiten Gesellschaft, the well known German glider association. This is powered with a D.K.W. engine of only eight horsepower; nevertheless it attains a speed of 77 miles per hour. A closed single-seater cabin is employed and simplification as compared with the conventional airplane is carried still further because there is no landing gear — nothing but a skid under the nacelle, with an attachment at its rear end for launching by means of a rubber catapult.

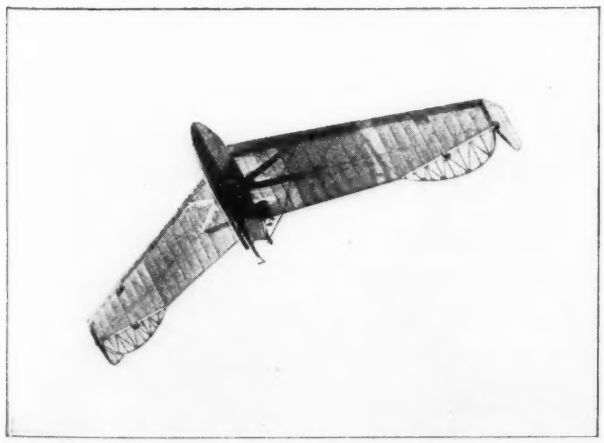
At the tips of the wings are two hinged surfaces, which when moved together evidently serve as an elevator, and when moved separately serve as ailerons. Such independent or simultaneous control is readily achieved by simple mechanical means. At the same time the Rhön-Rossiten light plane is provided with a rudder and fin as can be clearly seen in the photograph, and is therefore a three-axis control machine. The wings are of very high aspect ratio (which shows glider influence) and are braced by external struts.

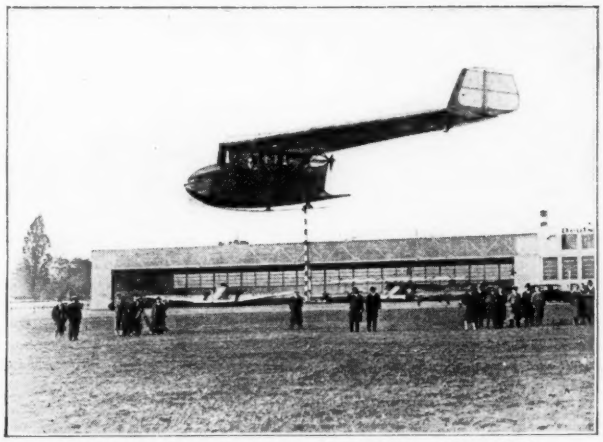
We may add that neither the Espenlaub nor the Rhön-Rossiten tailless planes are novel.

Some time before the war we had the Burgess-Dunne built and flown at Marblehead, Massachusetts, which had similar construction of wings and controls, was ap-

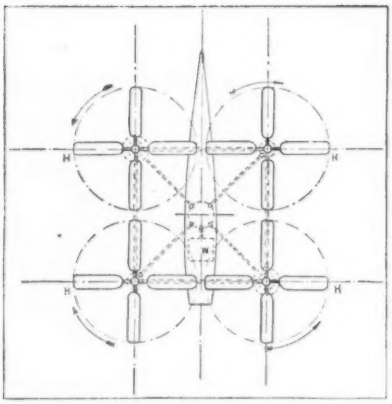


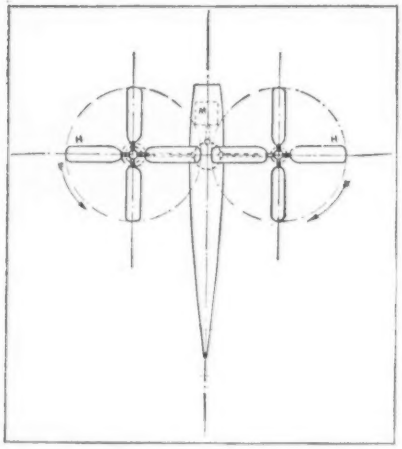






***Upper left*: Three quarter front view of a light tailless plane, a two-seater using a Bristol Cherub engine. *Upper right*: Three quarter rear view of the same plane, showing the two hinged control surfaces. *Lower left*: The Rhön-Rossiten tailless plane with a skid in lieu of landing wheels. *Lower right*: The same plane landing**





Above: **True helicopter, with four lifting screws.** ***Below:*** **Helicopter with only two lifting screws**

parently promising and was only abandoned because it showed too much instability near the ground, and responded to the action of every gust too readily. In England, Captain Hill's Pterodactyl built two or three years ago, was also based on similar principles and gained much interest.

It is peculiar that these tailless, swept-back wing planes come into the limelight from time to time, fly with apparent success and then disappear. Perhaps the Germans will be more persistent in testing their possibilities to a finish.

Classification of Helicopter Systems

IN our issue of July 1929, we discussed the Isacco helicogyre, now being constructed experimentally under the auspices of the British Air Ministry.

Signor Isacco was led to the invention of the helicogyre by a consideration of the difficulties of the various forms of helicopter. Since the helicopter is of perennial interest, it may be of interest to review the various systems which Isacco studied prior to the design of his own machine, and which he discussed in a paper presented before the Royal Aeronautical Society.

The broad classifications of the direct-lift machine are somewhat as follows:

1. The true helicopter; that is, a craft without fixed sustaining surfaces.
2. The helicopter-airplane, in which lifting screws work in conjunction with fixed airplane surfaces.

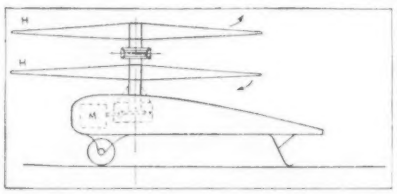
The true helicopter has been built with four lifting airscrews, each on a separate axis. This type is shown diagrammatically. Machines of this type have been built by Breguet and Oehmichen in France, and by De Bothezat in the United States. The airscrews turn, two by two, in opposite directions. The possibilities of such craft at first appear attractive.

With four airscrews, it is possible to have a large lifting area without excessive propeller dimensions. The airscrews can be arranged to have a longitudinal dihedral; that is, the front screws at an angle to the rear screws, and this, by analogy with the airplane, may be expected to give longitudinal stability. The airscrews can be arranged to have a lateral dihedral; that is the screws on the right side may be placed at an angle to the screws on the left side, thus offering the expectation of lateral stability, again by analogy with the airplane. By providing independent variation of pitch for each screw, it is possible to provide lateral and longitudinal control.

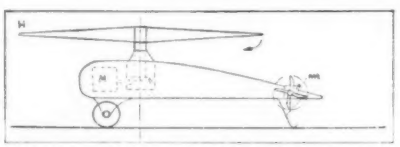
The difficulties of such types in practice are the complications of the mechanical system, excessive weight of the structure, and the fact that such machines will fly in any direction with equal facility. Thus a gust tilting the machine down by the tail may also induce backward motion.

Another variation of the true helicopter is the two-screw machine. Here the mechanical difficulties are somewhat diminished, but there is difficulty in securing longitudinal control in vertical ascent or in hovering.

There have also been helicopters with two screws rotating on the same axis and with one screw mounted above the other. Further simplification is obtained at the



Above: **A helicopter with two lifting screws on a single axis, but operating in opposite directions.** ***Below:*** **A single screw helicopter with auxiliary screw and motor at rear to take up torque of rotation**



expense of stability, (as shown by the test flights of Pescara and others).

Still another line of approach (made by Baumhauer, for example) consists in using a single rotating airscrew and in counteracting the torque of rotation by disposing an auxiliary screw at the rear of the machine. Here again mechanical difficulties intervene.

The combination of a fixed wing surface with lifting screws has been investigated exhaustively by Berliner and is now being tried out by Johnson in Wisconsin. The difficulty is that two principles are confused. The resulting machine is likely to be a poor helicopter or direct-lift machine, and a poor airplane in horizontal flight.

Besides the mechanical troubles, and the dubious stability, the helicopter offers tremendous problems in control under all circumstances and particularly in descent with the engine shut off.

Innumerable patents have been taken out which indicate plausible helicopters on paper. The jump from a patentable idea to a practical helicopter is stupendous.

Modern thought on the helicopter seems to incline away from gearing and transmission. Thus, the La Cierva autogiro employs a huge windmill, driven only by the wind of forward motion. It does not pretend to be a direct-lift machine, but provides very slow landing and a short landing run.

The Curtiss helicopter, now in process of construction, avoids gearing by having a single rotating airscrew which is driven by small engines each operating a propeller and mounted on the large lifting blades, with translation attained by inclining the whole craft.

Isacco provides two or more lifting blades with independent engines driving auxiliary propellers, while a propeller placed at the front end of the machine gives propulsive force.

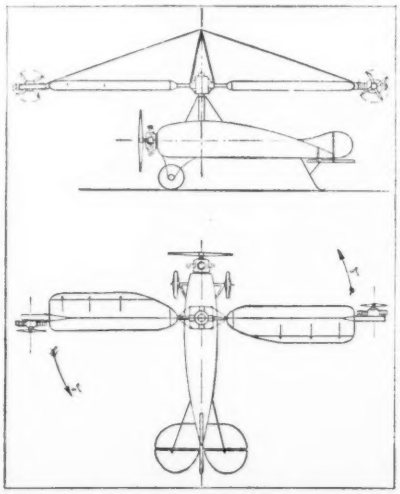
The amount of money, ingenuity, and trouble spent on the helicopter without tangible results is extraordinary. It is one of the mysteries of aeronautics as to whether success will ever be attained.

Black's "Transport Aviation"

IN spite of the rapid growth of air transportation, the number of authoritative texts on the subject remains very small. We therefore welcome the second edition of Black's "Transport Aviation" (published by Simmons-Boardman, New York) which is now a composite work, written by a large number of specialists, including Mr. Black himself, E. L. Jones of the Department of Commerce, Major H. C. Biddlecombe of Curtiss-Wright, John C. Leslie of the Aviation Corporation of the Americas, and other authorities. The subjects dealt with are Aviation Law, Air Routes, Traffic Development, Advertising Safety, Design of Planes, Engines, Airways and Airports, Ground Equipment, Radio Communication, Financial Aspects, et cetera.

It may be of interest to note what the future holds for us, at least in the opinion of the authors:

"The general spread of aviation in the past several years has brought a universal willingness to fly—a condition distinctly



The Isacco helicogyre

differing from that of post-war days. The prejudice against air transport having disappeared, only its high cost is the retarding factor at present. . . . This cost is falling steadily and will continue to fall so far as we can look into the future.

"The railroads will doubtless continue to carry all of the local first-class mail and will be co-ordinated with the air service to act as feeders on the longer hauls.

"It may be set down as a cardinal principle that the railroads or ships or road vehicles have no excuse for carrying mail where it is practical to use aircraft."

The authors also have a prediction to make on the subject of new types of airplanes: "Mail airplanes with facilities for sorting en route, and passenger airplanes with sleeping berths. . . ."

This is a workmanlike, authoritative book, which should be in the library of everyone interested in air transport.

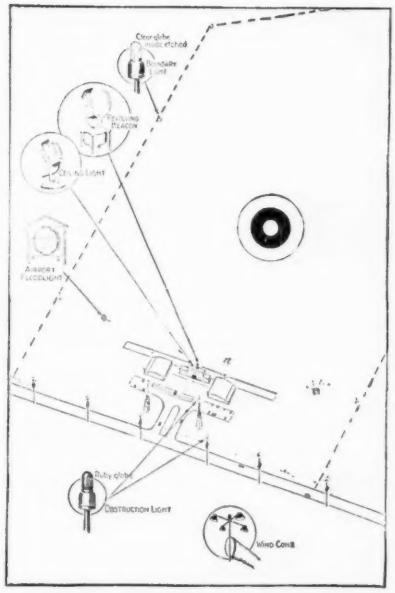
What Businesses Use the Airplane?

AN airplane manufacturing firm, the Ryan Aircraft Corporation, has made a survey of business houses employing the airplane. There are now 135 corporations using planes for their salesmen and executives, for transportation of parts, and so forth. The survey shows that four, six, and eight-place cabin planes, powered with single engines are used almost entirely by such corporations. The oil companies are the largest users, but insurance companies, contractors, express companies, power companies, advertising agencies, roofing manufacturers, automobile firms, tire companies, department stores, and publishing houses are all represented. Altogether 45 different lines of business were discovered as present users. The companies report that a six-place cabin plane costs $0.252 per mile to operate, making allowance for every expense such as depreciation, pilot's pay, insurance, hangar rent, overhauls, gas and oil, and so forth.

Russel L. Putman, a Chicago publisher, in a paper read before the Society of Automotive Engineers, cites three outstanding objections to be overcome before the purchase of planes by business houses becomes more general. These are: lack of confidence as regards safety; high cost; and lack of understanding of the airplane's use. Mr. Putman believes that newspaper comment on aviation does not do much to remove these objections, because it deals mainly with the spectacular, and so he advocates paid advertising. We believe he is quite right, and that systematic advertising by airplane manufacturers is absolutely essential.

A very encouraging piece of news in this regard is the purchase of light *Aristocrats* by the General Tire and Rubber Company of Akron. The planes are painted black-and-orange, piloted by Army fliers on leave, and are to make a year's tour of the country. The tour is designed to test the general applicability of the airplane for commercial purposes. Observations are to be made on the effect of weather on all flying, on take-offs and landings in all kinds of fields, and on the wear and tear of landing tires and landing gear. The tour is to cover 50,000 miles and will take the fleet to all parts of North America. It is understood that in the first six weeks of the tour there has not been an hour's delay due to any mechanical trouble with the planes, although there have been engine and carbureter troubles.

The *Aristocrat*, built by the General Airplanes Company, is a likely sort of plane. It has seating capacity for pilot and two passengers in its closed cabin, and a pay load of 476 pounds. Equipped with the Warner engine of 110 horsepower, it has a cruising speed of well over 90 miles per hour when loaded to its full weight of 2000 pounds. As our photograph shows, the *Aristocrat* has the familiar semi-cantilever wing bracing. The landing gear is of entirely cantilever construction, with two solid streamline members on either side. Certainly a trim and comfortable plane such as this should have an appeal to American business.



The *Aristocrat* monoplane, a three-seater cabin type

Airport Lighting

THE National Lamp Works of the General Electric Company has issued a pamphlet entitled "Looking Ahead in Airport Lighting" which is of fascinating interest.

We had a notion that a stupendous amount of energy is employed in aviation lighting. Large theaters employ from 50 to 500 kilowatts for lighting only the stage. Electrical advertising signs may use as much as 300 kilowatts. Lighted airports employ only 25 to 40 kilowatts. Evidently airport lighting is quite meager, and its intensity is sure to be increased in the future.

Lighting is, quite rightly, one of the three major requirements for obtaining an airport rating from the Department of Commerce. Our diagram shows a typical airport layout, with the various types of lighting required. The following are the minimum requirements for a class "A" airport:

Airport Beacon. The minimum candlepower must be not less than 100,000 for long range and in no case less than 15,000 candlepower. The beacons are rotating or flashing with flashes of not less than one tenth second duration. Light distribution must be visible all around the horizon and to the zenith or nearly so.

Minimum lighting facilities required for a class "A" airport

Boundary and Obstruction Lights. Either 600-lumen series or 25-watt multiple lamps are employed in clear weather-proof globes mounted on standards 30 inches above the ground, and spaced not more than 300 feet apart to outline boundaries. Green is substituted for white to show the points of best approach, and red globes to show hazardous approaches. The utility of these lights to the incoming aviator is obvious.

Wind Cone and Hangar Lighting. The wind sock, as the wind-direction indicator is called familiarly, must be so lighted as to be visible 1000 feet in all directions if externally floodlighted. The exterior surface of each hangar must be floodlighted to two and one half candles.

Ceiling Light. One of the most useful pieces of airport equipment is the ceiling light, which is projected until a cloud is hit, so that by measurement on the ground of the reflected point, the ceiling or height of the clouds may be determined.

Field Floodlighting. One or more illuminating units are used to provide an even distribution of illumination without shadow areas and of sufficient illumination to make the ground details visible from an altitude of 30 feet. The system must be controlled from a convenient point and be sufficiently flexible to permit landing under all conditions of wind direction without the necessity of landing directly towards the light source.

The care that is evident in the regulations of the Department and in the development work of various airport lighting companies is remarkable.

European Research

THE October *Journal of the Royal Aeronautical Society* contains a number of authoritative papers on the progress of aeronautical research in various European countries.

In France, considerable attention is being paid to the problem of flight on one engine with a twin-engine airplane. One of the factors which militate against this opera-

(*Please turn to page* 88)

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

New Method of Curing Concrete Supersedes Usual Straw Covering

SODIUM silicate is one of the most versatile chemicals. An adhesive for a thousand different applications, a detergent in dozens of washing operations, a water softener, and in hundreds of other rôles, this ubiquitous mixture of sand and soda plays its part, from preserving eggs to improving paint. Now comes a new application which promises to be visible to every motorist, for sodium silicate seems to offer many advantages as a medium for "curing" concrete highways.

Everyone is familiar with the traditional method of curing a new concrete road by covering it with straw which is periodically moistened. This treatment is designed to prevent too rapid drying of the fresh concrete, in order that the new road may attain its full strength and permanence. Wet straw does the trick nicely, if kept wet, but very often this is not done carefully. The findings of the Maryland Road Commission, working in co-operation with the United States Bureau of Public Roads, reveal an effective curing agent that is not so dependent for its success on the human element.

Silicate of soda, in these experiments, produced concrete as strong as that cured with wet earth; in fact, silicate-cured concrete at the end of six months had a crushing strength of 5364 pounds in comparison with 4855 pounds for concrete cured with wet earth. Also a study of the number and distribution of cracks showed that on this job the section cured with silicate of soda had the least number of cracks.

It has been found that the silicate for concrete curing should have a ratio of 1:3.25 or 1 part sodium oxide (Na_2O) to 3.25 parts of silicon oxide (SiO_2). This is now available to contractors at a density of 42.25 to 42.75 degrees, Baumé.

Since the gravity of the silicate as applied is 36-37 degrees, Baumé, it is diluted on the job. This is easily done by adding about one gallon of water to four gallons of silicate. Checking with a hydrometer is important to be sure of the specific gravity.

To spread the silicate on the road, it is poured from pails or sprinkling cans, although some contractors use sprayers. A soft brush, mop, or push broom is all that is required for a spreader. When the silicate is spread the contractor's work is done. One application is all that is needed. A second application becomes necessary only if it has rained within six hours after the original treatment. There is no further attention required. Wet earth or straw curing involves extensive water lines, labor for an additional 10 days at least, and then the cost of removal. With silicate curing there is nothing to be removed. The appearance of the road is the same as it is with any other curing.

Humidity Effects Motor Performance

POPULAR beliefs, scorned for a time as superstitions, are often later found to have at least a partial basis in fact. The idea that smoother performance is obtained in wet weather is firmly intrenched in the minds of most automobile drivers.

This impression is doubtless partly the result of psychological factors, and partly a real absence of squeaks caused by the lubrication of the springs by water. However, recent tests at the United States Bureau of Standards indicate that it may result partly from mechanical factors. These tests show that increased atmospheric humidity, or "wetness" reduces the maximum power obtainable and slows up the combustion, the effect of both of which would be to give a smoother flow of power.

The loss of power is proportional to the humidity, and under extreme atmospheric conditions may amount to 10 percent of the total power of the engine.

Although by proper adjustment of the carbureter, equally efficient operation can be obtained irrespective of the humidity, in the absence of such adjustment, less efficient performance normally will be obtained under conditions of high humidity.

Superior Lacquers From Vinyl Resins

LACQUERS that are waterproof and more highly resistant to wear and tear than anything heretofore known are foreshadowed by the development of new synthetic resins which can be used as a base for entirely new surface coatings. Mention is made in these columns (see page 76) of "Glyptal," a new synthetic resin made from glycerine and phthalic anhydride. Now comes another series of synthetic resins promising even wider scope of application, the vinyl resins.

The development of these remarkable compounds was described at a recent meeting of the American Institute of Chemical Engineers by J. G. Davidson. After tracing the remarkable growth in the production of nitrocellulose lacquers and the corresponding decrease in the costs of the aliphatic chemicals and solvents that enter into their formulation, Mr. Davidson demonstrated the properties of some of the most interesting of the newer synthetic resins.

For more than two years his company has been working on the polymerized vinyl compounds, which are of particular interest

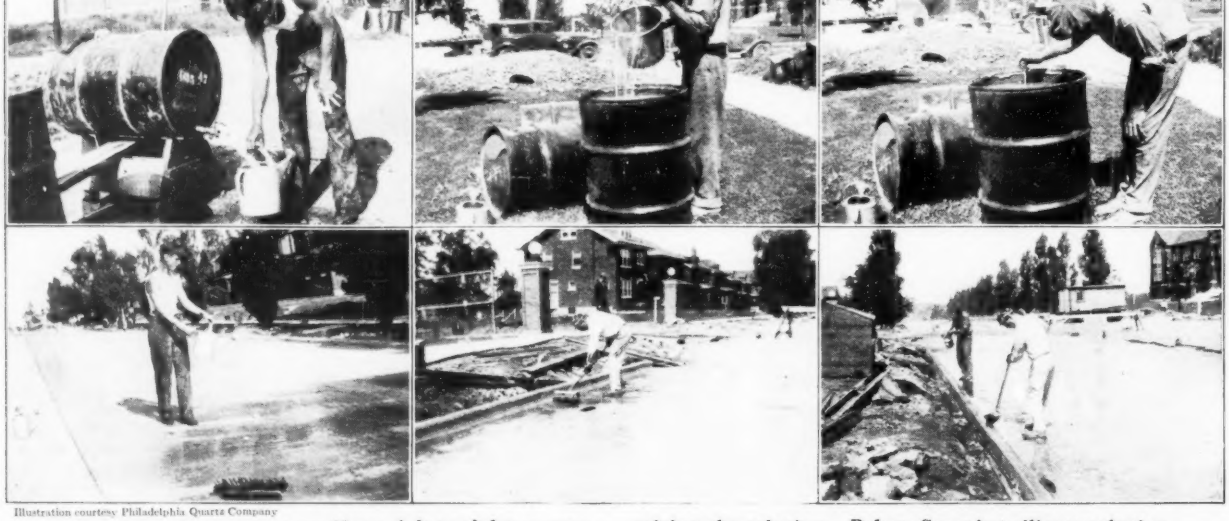


Illustration courtesy Philadelphia Quartz Company

Steps in curing concrete. *Above, left to right*: removing silicate of soda from drum, diluting with water, and mixing the solution. *Below*: Spraying silicate solution on fresh concrete and smoothing it over concrete road

in lacquers because they dry in a similar manner to paint and varnishes; that is, by polymerization rather than solely by evaporation, as is the case with lacquer. This means that more film-forming constituents may be left on the surface than with lacquers. Thus while the total solids in a lacquer rarely exceed 25 percent, in varnishes and paints and likewise in vinyl resin lacquers, it is possible to reach 50 to 60 percent of total solids.

Lacquers made with the vinyl resins, according to Mr. Davidson, are waterproof, remarkably resistant to acid or alkali, and can be produced in any colors. The same resins which are to be known by the trade name of Vinylite are thermoplastics and can be molded with or without fillers in any colors, including ivory white. They appear also to have advantages in impregnating fabric, paper, and wood. Their development marks the beginning of a steady evolution through which the lacquer industry will grow to increased size and economic importance, largely as a result of parallel developments in the field of synthetic aliphatic chemistry.

Mineral Wool Made From Lead Slag

A CHICAGO concern has worked out a process for making mineral wool from slag. This mineral wool, which is being put upon the market under the trade name of Therm-O-Proof, is a fluffy and light substance that will not burn or melt at less than 2500 degrees, Fahrenheit, and is being used for insulating material. The only plant manufacturing this wool at present on a commercial scale is at Alton, Illinois, where it is being operated on slag obtained from the lead refinery plant of American Smelting and Refining Company.

Approximately 50 tons of this material is now being turned out daily in Alton, and very soon this output will be increased. It will be marketed in four forms; loose wool, in blanket form, in board and bricks. The principal uses of the material are in building insulation, high and low temperature insulation, sound deadening, and fireproofing.

"Eskimo Pie" Idea Applied to Wolf Poison

NOT all the ingenious discoveries of chemists originate in laboratories. In fact, one triumph of science we recently heard of was achieved by the versatile scientist's familiarity with Eskimo Pie. One of the clients of Arthur R. Maas, consulting chemists of Los Angeles, asked the chemists to prepare a tasteless strychnine for poisoning wolves, foxes, and other predatory animals that kill sheep and cattle. Strychnine is very bitter, and if the "varmints" taste it, they cough up the baits. Also, a quick-acting form was wanted so the furs could be recovered before being damaged.

"We tried mixing with disguising materials, like sugar," said Mr. Maas, "but with no success, as the bitter taste remained. Then, with things that dissolved slowly in saliva—that was too slow. Then we remembered that a chocolate-covered ice cream bar seems to lack taste, and as a layer of wax separates the ice cream from the chocolate, we tried incorporating strychnine with wax. Complete success! The wax protects the poison from saliva, and it is swallowed without being tasted. In the stomach the wax soon dissolves by warmth, and there is a quick kill."

The formula has been highly effective in killing wolves and foxes, and the ranchers now welcome prowling animals because they drop before they do any damage and their skins pay a nice profit.

Bacteria May Supply Chemicals

FERMENTATION methods still play the most important part in solvents production, according to a paper prepared by F. M. Crawford for the Institute of Chemical Engineers. Starting in 1920 with an output from only a few fermenters, the demand from the lacquer industry for n-butyl alcohol has increased by leaps and bounds until in 1929 approximately 150 fermenters, each of 50,000-gallon capacity, are needed to keep up the required rate of production. The original plant capacity at Terre Haute, Indiana, was soon outgrown. A second and a third plant were built at Peoria, Illinois.

During the fermentation, tremendous quantities of gases are given off, consisting of a mixture of approximately 40 percent of hydrogen and 60 percent of carbon dioxide. More than half of the carbohydrate entering into the fermentation process goes into the formation of these materials, which at the Peoria plant are are being converted into synthetic methanol.

Mr. Crawford predicts that bacteria will play an increasing part in the production of commercial chemicals and foresees a time when our exhausted petroleum reserve will be replaced by fermentation processes for the manufacture of the many solvents and chemicals which are now derived from petroleum.

Diphenyl as a Heating Medium

ONE of the most spectacular developments of an erstwhile rare chemical to an everyday commodity for entirely new uses is exemplified by the application of diphenyl as a heating medium. This organic solid changes to a gas at 484 degrees, Fahrenheit, and is therefore ideal for a heating medium between that temperature and 750 degrees, Fahrenheit, just as water, for instance, is an ideal medium for the temperature range covered by steam. The most important application of the new heating medium seems to be in the Govers process for refining lubricating oils.

A. E. Wells, a consulting engineer of Cambridge, Massachusetts, read a preliminary paper on the use this process makes of diphenyl as a heating medium in distillation at a recent meeting of the Institute of Chemical Engineers. Dr. Francis X. Govers, director of research for the Indian Refining Company, answered questions and demonstrated the operation of the process. The problem of producing a special grade of lubricating oil distilling between 485 and 625 degrees, Fahrenheit, called for the use of an indirect heating medium. After considering various low-melting metals, mercury, and sulfur vapors, it was decided to use diphenyl, which has a vapor pressure of 110 pounds at a temperature of 750 degrees, Fahrenheit.

There is apparently no decomposition at this temperature, for Dr. Govers reported that when used continuously in their apparatus for over six months, the make-up amounted to less than ½ percent. Diphenyl produced for this process on a commercial scale for the first time by the Federal Phosphorus Company, of Birmingham, has a melting point of 158 degrees, Fahrenheit, a boiling point of 474 degrees, Fahrenheit, and a specific heat of 0.4. Its thermodynamic properties are being studied at the University of Michigan and elsewhere.

In the Govers process the diphenyl is vaporized in a tubular heater similar to a modern boiler and the vapors pass to a single-effect vacuum evaporator where a mineral oil fraction between 485 and 625 degrees, Fahrenheit, is volatilized and taken off in an overhead condenser. Pressure in the still is about five millimeters. It is reported that with a waste heat boiler the entire process has shown a thermal efficiency of 83 percent.

Spectrum of Chlorine Gas

VALUABLE additions to our knowledge of the spectrum of chlorine, an element whose spectral characteristics have been practically unknown heretofore, and data tending to show that so far as we are now aware, chlorine does not exist in the sun, were made available to physicists and astronomers through a report published in the June 1929 number of the Bureau of Standards *Journal of Research*.

Several years ago Prof. H. Kayser, of the University of Bonn, in reviewing the research work done on the spectrum of chlorine, made the statement that, in spite of all the investigations that had been made up to that time, the spectrum was still practically unknown. The cause for this situation lies in the fact that chlorine is a difficult element to observe spectroscopically. When an electric charge is passed through the gas at reduced pressure in a glass tube, it rapidly enters into chemical combination with the hot metal electrodes and the discharge tube soon becomes useless. This defect has been eliminated in an experimental procedure at the Bureau, whereby a small portable chlorine generator is attached to the discharge tube, thus permitting small amounts of the gas to be admitted to the tube to replace that which has combined with the electrodes.

With such a tube it was possible to produce the spectrum of chlorine for the long periods of time (up to 15 hours) necessary to photograph it in the regions where it had never previously been observed. As a result of this new investigation our knowledge of the spectrum has been extended from the wavelengths visible to the eye in the violet and blue to those in the infra-red, beyond the limit of visibility, but capable of being photographed with specially sensitized plates.

Our modern theories of the structure of the atom enable us to predict the type of spectrum which the atom will radiate when it is losing the energy imparted to it, say, in an electric discharge. These new spectrum lines have been classified into spectral series and it is found that these conform in every detail to the theoretical requirements.

Steel-Coated Paper Money

NO sooner does the government reduce the size of paper currency than the chemist comes along with a plan to make money last longer. By means of a process developed in the laboratory of Dr. Schoop, of Zurich, and reported by *Chemistry and Industry*, banknotes are coated with a

particular steel alloy in such a way that metal and paper are firmly combined without damage or alteration to the paper. In addition to such advantages as durability, it is claimed that the metallized notes can not be forged.

Synthetic Lacquer Has Synthetic Name

IT is only five or six years since "Duco" and other pyroxylin lacquers made their appearance in the paint and varnish field and began the conquest that left them supreme in certain important applications. The development of the quick-drying pyroxylin lacquer has been the sensation of the protective coating industry during the past decade. Yet the tempo of science and industry is so fast that already a new pretender for the throne of pyroxylin is marshalling his forces in American chemical laboratories, and some scientists are anticipating a new conquest by synthetic resin lacquers.

Chief among the picturesque resin aspirants to supremacy is Glyptal—a synthetic resin with a synthetic name, formed from the words "glycerin" and "phthalic anhydride," the two substances from which it is made. Developed in the great research laboratories of the General Electric Company, Glyptal is the result of a successful search for an improved synthetic non-conductor of electricity. In its solid form it is a resin somewhat similar to the well-known Bakelite; when dissolved, it produces quick-drying lacquers with surprising qualities which are winning new converts and customers every day.

The first commercial applications are for sealing joints in gas mains, for painting structural iron, motors, oil tanks, metal parts of ships exposed to oil or vapors, fire hydrants, ship hulls, mine machinery, and similar equipment requiring sealing and insulating paint. The General Electric Company is marketing a series of Glyptal lacquers in colors, for use where an oil-resistant, highly protective, durable, and flexible insulating coating is demanded.

These paints possess many desirable qualities, including resistance to acids, mineral oils, weather, and alkalies, as well as adhesion to any surface and protection against rust. The Glyptal lacquers have been found superior to ordinary protective paints, in that they are more easily applied, dry faster to a coating of more pleasing appearance, are more resistant to acids and mineral oils, and are less affected by high temperatures. They withstand temperatures destructive to the commonly used paints, and also have a greater dielectric strength.

These new lacquers are now available in five colors—red, blue, brown, green, and aluminum. They may be applied by brushing, spraying, or dipping, dry dust-free in about 30 minutes, and in approximately ten hours to a hard smooth finish which is not brittle and can be cleaned easily. When using Glyptal lacquers as a finish, no priming or sizing is necessary.

Mold Used to Make Gluconic Acid

THE despised mold, popularly considered only destructive, is now used in the making of a health-giving product by the United States Department of Agriculture. The process of putting molds to work in producing gluconic acid, used in making an expensive calcium salt with highly important medical qualities, was discovered and recently perfected by Horace T. Herrick and Orville E. May, chemists in the Bureau of Chemistry and Soils of the department. By the new method, this salt is reduced in cost from about 15 dollars a pound to 50 cents a pound. "This," says Dr. Henry G. Knight, Chief of the Bureau, "is an example of the manner in which the bureau is using apparently useless organisms to create valuable chemicals.

"The calcium gluconate which is made from the gluconic acid produced in the Color and Farm Wastes Division of the bureau is now regarded as the only calcium salt which can be injected between the muscles, in the treatment of certain ailments of man, without causing abscesses. In common with other calcium salts it can be injected into the blood stream or given through the mouth and, in contrast to the exceedingly disagreeable taste of other calcium salts, it is practically tasteless.

"Until Mr. Herrick and Mr. May discovered the kind of mold that produces gluconic acid, learned to feed this mold the right amount of glucose, learned to keep it in a liquid of the right temperature, perfected large containers which would not corrode from the action of the acid and finished other laborious research, calcium gluconate remained a rare medicine, manufactured by chemical processes and held at exceedingly high prices by certain European manufacturers."

It is believed that calcium gluconate, when fed to high-production hens which lay thin-shelled eggs, may have a marked and unusual effect in thickening the shells. It is considered possible that the textile and tanning industries will also make use of gluconic acid.

Extend Investigation of Rare Gases

IN our June, 1929, issue we described the process of manufacture of the glowing colored tube electric advertising signs, explaining the effects produced by the use of neon, argon, helium, and mercury vapor in the tubes. We are reproducing this month a photograph showing an important step in the manufacture of these popular advertising signs in which the air is completely exhausted from the tubes before the introduction of the rare gases.

The popularity of these advertising signs has opened up a tremendous field for neon gas, which was previously nothing more than a chemical curiosity. Now we are informed that new possibilities for the commercial development of still other rare gases are in prospect as a result of the research work of a French chemist, M. Lepape. He has succeeded in obtaining appreciable quantities of krypton and xenon, both of which are present in the air in minute quantities, by fractionating the residual gases from liquid air. In apparatus of the type used by Claude for the liquefaction of air, the krypton and xenon are entrained in the ebullition of liquid oxygen. In order to reduce loss of these gases through mechanical entrainment, M. Lapape employs fractionation by means of adsorption at the temperature of liquid oxygen. By using coconut charcoal or silica salt with the liquid oxgen in the process of evaporation, the mixture becomes enriched in krypton and xenon, which are subsequently separated by fractionation on the coconut charcoal. By this method M. Lepape has been able to recover from air several liters of krypton and one liter of xenon.

Wanted: Uses For Columbium

AT the recent Chemical Exposition, in New York, columbium was exhibited for the first time. Because of the remarkable properties of this new metal, speculation was rife among chemists as to where application of the newcomer would first be made. The metal exhibited is said to represent all of the metallic columbium in the world. The metal has an atomic weight of 93.5, its specific gravity is 8.3 and its melting point is about 1950 degrees, centigrade.

Columbium is silvery in appearance and may be coated with iridescent, colored oxides by electrolysis. Like tantalum, it is inert to practically all chemical action and is soluble only in a mixture of nitric and hydrofluoric acids. The metal readily absorbs gases by occlusion, is very ductile, and may easily be worked cold. It may

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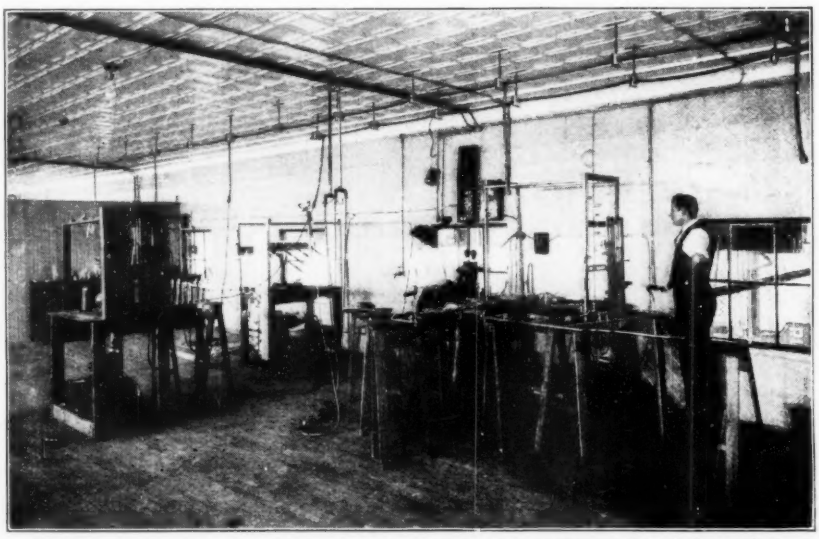


Electrical evacuating apparatus, used in removing air from glass tubes prior to the introduction of luminous gases. A current of 16,000 volts is required

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

The Composition of Cigaret and Cigaret Smoke

DR. EMIL BOGEN has made available the results of his investigation of cigarets sold in the American market. More than 286 brands are purchased by American smokers, varying from pure oriental cigarets made of Turkish and Egyptian tobacco to the pure domestic brands made of Virginia and Carolina tobacco. In addition, there are innumerable blended tobaccos of which the most popular cigarets are typical, as well as denicotinized tobacco cigarets and tobacco-free cigarets. In his investigation, Doctor Bogen found that it was not possible to differentiate regularly between cigarets of the same class, but that experienced smokers when blindfold can tell the difference between cigarets of different classes.

The moisture content and nicotine content of tobacco varies. Domestic brands average 2.50 percent of nicotine, blended tobaccos 1.90, oriental tobaccos 1.44, and denicotinized tobaccos 1.10. There is thus but a small limit of differentiation in nicotine content between denicotinized and oriental tobaccos.

Doctor Bogen recognizes that the chemical composition of the cigaret is not the only factor that may affect the response of the smoker. There is the inhalation of the smoke, the heat, and the deposition of the ingredients in the tissues. In an interesting table, Doctor Bogen contrasts the pains and pleasures of cigaret smoking as represented by the average number of men undergoing blindfold tests.

Pains and Pleasures of Cigaret Smoking

Percentages reported by subjects of blindfold tests.

I. The Pleasures of Smoking	Percent
Sociability	65
Fragrance	60
Relaxation	50
Stimulation	50
Steady nerves	45
Smoothness, mellowness, and soothing	35
Quieting hunger	30
Sight of the smoke	25
Feel in the lips	25
Feel in the hand	10
Taste	5

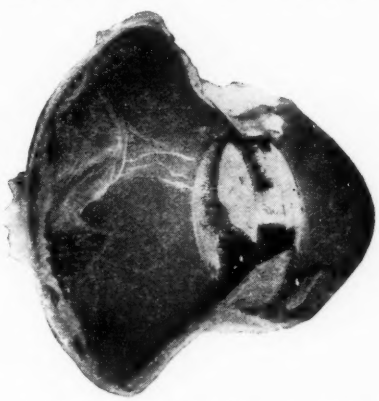
II. The Ill Effects of Smoking	Percent
Shortness of breath	35
Biting and irritation	30
Coughing	30
Burning	15
Nausea	10
Palpitation of heart	5
Hoarseness	5
Salivation	5

A definite relationship was also found between underweight and persistent use of tobacco. Those who use no tobacco were usually overweight and showed a lower incidence of colds and respiratory diseases.

The Lens of the Eye

ALMOST everyone knows that the eyes of animals, insects, and fishes are adapted to the nature of their lives. This applies not only to the retina of the eye, the portion which accurately conveys the vision to the brain, but also to the lens of the eye which acts as a mechanism for focusing the image on the retina.

Dr. John O. McReynolds has made extensive studies of the lens of the eyes of various species, which indicate some of the remarkable conditions that exist. There are some beetles which have thousands of eyes and thousands of lenses. Consider the marvels of the mechanism of the eye of a bird which enables it while flying swiftly to alight with accuracy on a swinging telephone wire or to catch in its beak an insect flying in a diverging course. The eyes of many species are both telescopic and microscopic. The eyes of fish are adapted to the medium in which they live. The owl's eye is interesting, according to Doctor McReynolds, because of the prominent part that the cornea, which is the tissue over the eye, plays in helping the owl to see satisfactorily.



Owl's eye, *Bubo virginianus*. This represents a meridional section of the eye. The enormously protruding cornea is a combination of cylinder and cone and performs an exceedingly important function in the refraction of light

The Malingerer

THE malingerer is usually mentally disturbed. In order to excite sympathy in one in whom he or she, and it is usually she, is interested, he will inflict all sorts of strange injuries on his person. Sometimes in order to avoid hard work or military service, he will claim deafness, inability to see, or even disturbance of the kidneys. During the war there were many such cases. Instances actually occurred in which egg white or similar substances were injected into the bladder so that excretions might reveal the presence of albumin on examination.

Among the strangest of all malingerers are those who inflict injuries on the skin. Every specialist in diseases of the skin has seen numerous cases of this character. Recently, Doctors Stokes and Garner of Philadelphia have described a remarkable case of this kind. A married woman, 40 years of age, developed typical hysterical symptoms, including attacks of rigidity, sleeping spells, and disturbances of vision, and at the same time white spots and scars on the skin. A specialist is able usually to detect the fact that the skin disturbance is self-inflicted.

Usually it is not an eruption on the skin, but an ulcer or an erosion due to the action of some burning or caustic substance. In 34 cases seen by one specialist, 14 were due to the application of carbolic acid or phenol, which had been used to produce burns and scars. Usually the interest of the specialist is aroused at once by the fact that the skin disturbance does not resemble any ordinary skin disease. However, it is possible to injure the skin merely by rubbing it with a wet finger or by applying sand-paper, acids, mustard, tobacco, or more caustic substances.

It is usual for the self-inflicted wound to be in a place that the hand can easily reach. In a left-handed person the scars are on the right side, and in a right-handed person on the left side.

Among symptoms of nervousness which are likely to appear in such people are bitten finger nails, bitten knuckles, and hangnails. Indeed, Doctors Stokes and Garner speak of the nervous restlessness, the slight tremors of the finger muscles, the easily moist or overbright eye, or the "poker" face of the outwardly calm, although inwardly tense, person as typical malingerers. In practically every case it is possible to find a background of motive which may be sexual or associated with a love affair. Jealousy, self-pity, and morbid craving for sympathy are the chief causes of malingering.

In the case of the girl in Escanaba some years ago who deceived physicians for many weeks with an extremely high fever brought about by touching the thermometer to the hot water bottle, it was the desire to attract the attention of some one who was not interested. However, in addition to the jealousy motive, there may be moral, religious, intellectual, or economic reasons for producing the disturbance.

An Exclusive Meat Diet

EXPERIMENTS just completed under the direction of Dr. C. W. Lieb served to confirm the observations made by the Arctic explorer Stefansson when he returned

from the far north after having lived for many years on what was practically an exclusive meat diet. At that time observations showed that no definite physical or other changes had occurred in Stefansson.

The people who opposed the eating of meat on prejudicial ground attempted to explain the facts by asserting that he had been able to withstand high protein and fat diet due to the cold air or to his vigorous exercise. As a matter of fact, summer heat comparable to that of our own country was experienced part of the time, and, indeed, winter temperatures in the far north are for the human being much like those of our own climate, because of the furs that are worn and the temperatures that are maintained in Eskimo houses.

For the purpose of the experiment, Stefansson and Andersen, who spent three years with him in the Arctic, consented to go on an exclusive meat diet for a year and to be studied from all angles during the period of the experiment. For a year, therefore, they lived on meat, most of which was cold-storage meat, although for a period of two months they had fresh meat. Calcium was obtained by eating the ends of the ribs and gristle. Very little salt was added to the food. Raw bone marrow was eaten as dessert at times during the year of the experiment. Coffee and black tea and water were the sole beverages and were taken unsweetened.

It is pointed out that both the men were excellent subjects from the psychologic point of view, since they had previously lived on limited diets and had no mental hazards as to the outcome. There was little if any change in their weights and no disturbances of the kidneys. The diets averaged 2600 calories per day. The blood pressure of Stefansson did not change and Andersen's blood pressure fell from 140 millimeters to 120 millimeters. There was no decrease in physical vigor and both men appeared ruddier at the end of the experiment than at the beginning. The teeth did not deteriorate, the bowels remained normal and there was no change in pulse, temperature, or ability to sleep.

It has been argued by some of the opponents of meat in the diet that the eating of meat brings into the bowels vast numbers of dangerous bacteria and therefore is bad for the human body. The investigation revealed the fact that the whole meat diet in both subjects caused a simplification of the germs in the intestinal tract and did not cause the development of putrefactive germs.

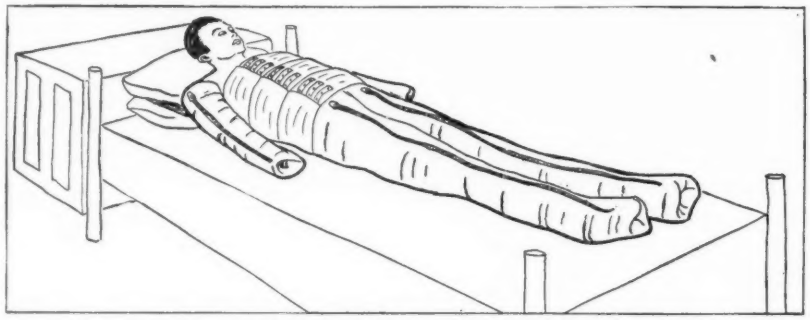
The results of this experiment should not be considered, however, as a recommendation for eating vast quantities of meat or of meat alone by the majority of people. The experiment does break down, however, the arguments of the vegetarians as to the dangers of meat. The fact remains that the best diet for the human being is a well balanced mixture of all of the foods commonly eaten by man, including meat, eggs, fresh vegetables, cooked vegetables, fruits, and cereal products.

An Apparatus for Muscular Relaxation

IT has been generally agreed that relaxation of the muscles, whether produced by mental action or by physical process, is conducive to sleep. Dr. Edmund Jacobson has devised a system called "progressive relaxation," in which the patient is taught in a series of lessons to relax muscle after muscle until he finally learns to relax his entire body. It has long been known that gentle massage and a hot bath will produce the same relaxing effect.

It occurred to Dr. Joshua Rosett to develop an apparatus which by alternately compressing and releasing the tissues would produce a similar effect. The device is like a union suit, made of strong inelastic rubberized cloth and is composed of a series of collapsible tubes which encircle the limbs and the body as high as the line of the armpits. By means of an air compressor and exhaust, compressed air enters the garment in such a manner that the tubes are momentarily inflated and deflated one after another in succession, in a direction from the extremities toward the upper part of the chest and shoulders. The degree of pressure is regulated by valves and the speed of the wave is regulated by another apparatus.

This garment has been in use, according to Doctor Rosett, for more than three years and people who try it say that it produces a gentle massage all over the body as if by many fine fingers. The uniform effect has been that of relaxation. Patients with nervous and mental diseases who are excited and do not sleep apparently fall asleep in this device. Experiments are being conducted to determine its usefulness.



An apparatus for the induction of muscular relaxation and sleep

Deaths from Pugilism

SOME time ago Dr. H. S. Martland pointed out that several puglists had died and others developed mental disturbances due to the development of a condition called "punch drunk." This condition is the result of small hemorrhages in the brain caused by repeated concussions. Recently pugilism has become more and more popular in Germany. Although boxing was common in ancient Greece and Rome, it did not become popular in Germany until after the World War.

Now the Germans are beginning to observe cases similar to those described by Martland. Kurt Wolff, the German pathologist, lists 25 deaths, in seven of which the fatality resulted from hemorrhage into the brain due to a blow on the side of the head.

The casualties in boxing are usually due to matching inexperienced boxers with better trained and heavier opponents, or to holding matches soon after a full meal or while the boxer is suffering from some disease.

Speech and Intelligence

THE mother is invariably interested in the question as to when the child will begin to talk. In the Institute for Juvenile Research in Chicago investigation was made of this particular point. The acquirement of speech is one of the most important functions in human development. Unquestionably speech is learned more rapidly in infancy than in adult life as everyone knows by comparing the ease with which language is acquired in infancy with the difficulty of acquiring a second language later in life. A thousand children were studied as to the age of onset of talking and walking, and this was compared with the mental age, intelligence quotient, nationality, and similar factors.

Doctors Abt, Adler, and Bartelme, who made the study, find that the range in onset of talking extends from 6 to 60 months for both boys and girls. The average age for talking for boys is 19 months and for girls 18 months. Practically all observers agree that girls learn to talk quicker than boys.

In comparing the age of onset of speech with intelligence rating, it is pointed out that the higher the intelligence the earlier the child learns to talk. The average age of speech onset was lowest in the Jewish group and highest in the group with both parents foreign born.

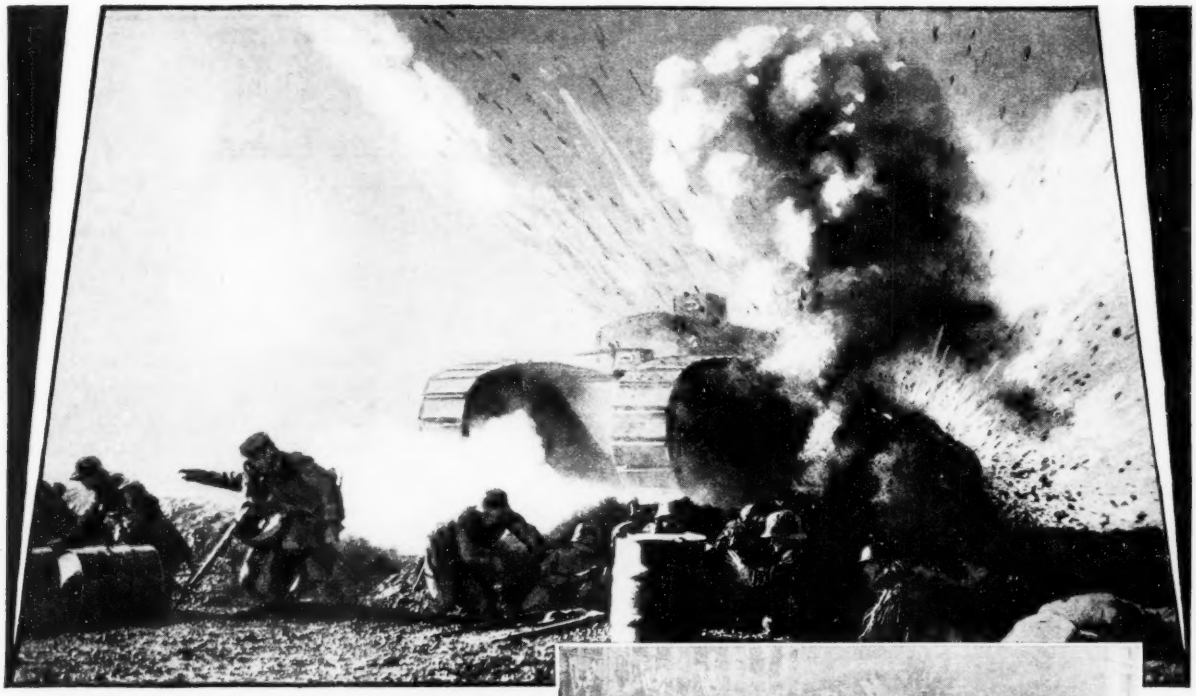
The average of onset of walking for both sexes is 16 months, ranging from 7 to 51 months for boys and 7 to 60 months for girls. There is also a definite relationship between the age at onset of walking and general intelligence.

It was noted in addition to this, that children who wet the bed at the age of three years or above learn to talk later than those who have established dry habits prior to that time.

The Hearts of Athletes

DURING the Olympic Games held in Amsterdam last year special studies were made of the hearts of the athletes by Doctor Herxheimer of Berlin who has for many years been interested in this subject. During the Amsterdam games, the hearts of 246 athletes engaged in various branches of sport were studied with the X ray before and after activity and their sizes were compared with the body weight.

Short-distance runners and athletes participating in a variety of sports had hearts which differed but little from those of the average men. The same is true of long-distance swimmers. On the other hand, marathon runners tax the heart severely, their hearts being the largest of athletes in any branch of sport. Next to the marathon runners were heavy-weight lifters and throwers, the oarsmen, and the long-distance bicycle racers. Boxers also place a heavy tax on the heart, as was shown by the high rates of weight and size of the organ in this type of athlete.



One of the Masonite Presdwood tanks used by Inspiration Pictures, Inc., at the Tec-Art Studios, Hollywood, California.

This tank looks like steel – *but is made of* PRESDWOOD

[If you are interested in any manufactured article, you can probably find ways in which Presdwood will lower your production costs and improve quality. Send for free sample and the Presdwood booklet. Just mail the coupon NOW.]

In both movie studios and factories, Masonite Presdwood is helping to win the war against rising production costs. In monster tanks of the feature film, "She Goes to War", this grainless wood forms most of the superstructure. Here Presdwood is used for its lightness, workability, smoothness, strength, and ability to take any finish.

Makes all these things

In great factories, carload after carload of Presdwood goes to the punch press, band saw, or milling machine to be transformed into useful articles. Presdwood makes iceboxes and incubators. It builds beehives and bird houses; is used in the manufacture of clothes hampers, bread boxes, breakfast nooks, kitchen cabinets, campers' tables, radio cabinets, speed boats, table tops, outdoor signs, and scores and scores of other interesting products.

Home mechanics use Presdwood for putting up light shelving, making small toys, or building a radio cabinet. Builders find Presdwood ideal for paneling fine homes and modern buildings. Contractors, employing Presdwood for lining concrete forms, find hand smoothing unnecessary except at construction joints, and thus effect savings of as much as 40 per cent in labor costs.

Manufacturers and builders have a wonderful material in this grainless wood, for it neither cracks nor splits, is highly resistant to moisture, and does not warp when properly handled. The Presdwood booklet explains its uses —tells how various finishes are applied. A copy is waiting for you and will be mailed on receipt of the coupon.

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111 West Washington Street, Chicago, Illinois

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Please send me, Free, a sample of Masonite Presdwood and the Presdwood booklet.

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Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

ELEMENTS OF MECHANICAL FLIGHT is a home study course offered to anyone in the country who desires aeronautical training. The assignments are presented in a non-technical manner so that even a grade school education is sufficient preparation. The course includes fundamental principles of flight, stability and control, the complete design and building of an airplane, flying instruction, and engines for aircraft. *Department of Engineering Extension, Pennsylvania State College, State College, Pennsylvania.—Inquire.*

Engineering

SELECTED PAPERS FROM THE JOURNAL OF THE INSTITUTE OF ELECTRICAL ENGINEERS OF JAPAN are issued in English either in full or in abstract, for the purpose of introducing to the Western public the gist of the papers published in the Journal of the Institute of Electrical Engineers of Japan. *Denki-Gakkwai, No. 3, 1-Chome, Yurakucho, Kojimachi-ku, Tokyo, Japan.—Prices Upon Request.*

ABRIDGED SCIENTIFIC PUBLICATIONS FROM THE KODAK RESEARCH LABORATORIES (Volume XII) is a compendium of many important scientific papers published during 1928. *Eastman Kodak Company, Rochester, New York.—Gratis.*

PLANS FOR SYSTEMS OF SEWERAGE, SEWAGE AND WASTE DISPOSAL is a 28-page pamphlet of particular interest to engineers engaged in the design of municipal, institutional, industrial, and private sewage systems. *Division of Sanitation, 23 South Pearl Street, Albany, New York.—Gratis.*

INDEX OF TECHNICAL REPRINTS gives the titles and writers of numerous reprints issued by the Bell laboratories to date. *Bell Telephone Laboratories, Incorporated, 463 West Street, New York.—Gratis.*

Industry

THE OXFORD PROCESS FOR THE PRODUCTION OF SUGAR FROM SUGAR BEETS is a report devoted to the development and costs of the Oxford dessication process, with statistics for comparing with the diffusion process. *Oxford University Press, 114 Fifth Avenue, New York.—85 cents.*

THE CONSERVATION OF INDUSTRIAL ACREAGE is a bulletin of the Pennsylvania Railroad showing the need for exercising wisdom and foresight in developing industrial property, and enumerates certain pitfalls to be avoided by owners of industrial property, leaders of business and civic associations, and municipal and state officials. Another recent publication of the company is entitled, WHAT TWO PENNSYLVANIA RAILROAD MEN SAW IN SOUTH AMERICA. Their story is very interesting. *Information Service, Pennsylvania Railroad, Philadelphia, Pa.—Gratis.*

LUBRICATION IN THE PRESENCE OF WATER, a special issue of one of the Texas Company's periodicals, discusses from various angles the problems concerning this type of lubrication and the most practical solutions thereof. *The Texas Company, 17 Battery Place, New York.—Gratis.*

EVERYTHING FOR MINE AND INDUSTRIAL SAFETY, including the Edison safety lamps, is a well-indexed 158-page catalog. *Mine Safety Appliances Company, Homewood Station, Pittsburgh.—Gratis.*

CARBON-BLACK IN 1928, by G. R. Hopkins and H. Backus of the Bureau of Mines, presents complete statistical data and summaries of the carbon-black industry in 1928, when it set new high records for both production and sales, due in part to the steadily increasing demand for rubber automobile tires. The figures show a consumption of nearly two pounds of carbon-black per tire. Most of the carbon-black is produced in Louisiana, Texas, and Wyoming. *United States Government Printing Office, Washington, D. C.—Five cents.*

NATURAL GAS PIPE LINES in the United States is a map showing the location of natural gas pipelines, and the natural gasoline and carbon-black plants of the country. *Bureau of Mines, Department of Commerce, Washington, D. C.—50 cents.*

Medicine

SAN FRANCISCO CANCER SURVEY, by Frederick L. Hoffman, is largely limited to Canada. The compilation is the fifth treatise of a series which began as a statistical survey of cancer on the Pacific Coast. *Prudential Insurance Company, Newark, New Jersey.—Gratis.*

ANNUAL REPORT OF THE MEDICAL DEPARTMENT OF THE UNITED FRUIT COMPANY is a well-indexed 378-page book covering the work done during 1928 in controlling malaria on the plantations of the company, and describes improved designs incorporated in new hospitals erected during the year. The book contains many valuable contributions by research specialists of the staff and others, dealing with various tropical diseases and other subjects of medical interest. *Medical Department, United Fruit Company, 17 Battery Place, New York City.—Gratis.*

Biology

PALEONTOLOGY AND THE EVOLUTION OF MAN, by D. M. S. Watson is the view of a conservative paleontologist concerning man's evolution. *Oxford University Press, 114 Fifth Avenue, New York.—70 cents.*

NEANDERTHAL (MOUSTERIAN) MAN, by Oliver C. Farrington and Henry Field, narrates in easily readable style the present knowledge concerning a race which maintained its existence in Europe for a period estimated at almost 100,000 years, and then became extinct after contributing knowledge of the uses of fire, improved stone implements, the beginnings of family and communal life, and some rudiments of a religious belief. *Field Museum of Natural History, Chicago.—25 cents.*

Miscellaneous

SUGGESTIONS TO AUTHORS contains pertinent information concerning manuscript preparation and book manufacture, particularly for writers in the technical field. *McGraw-Hill Book Company, Inc., 370 Seventh Avenue, New York City.—Gratis.*

REVISED ENCYCLOPEDIA OF CAGED BIRDS contains advice, suggestions, and information for pleasurable or profitable care of caged birds. Questions are answered concerning bird selection and breeding, treatment and feeding, diseases, types of cages, and methods for training certain types of birds. *Audubon Publishing Company, Louisville, Kentucky.—Paper 75 cents, cloth $1.50.*

WORLD POWER CONFERENCE, SECOND PLENARY MEETING, BERLIN 1930 is the title of a pamphlet which outlines the nature and purpose of the next World Power Conference. *Zweite Weltkraftkonferenz, Berlin NW7, Ingenieurhaus, Germany.—Gratis.*

BEYOND THE ELECTRON, by J. J. Thomson, presents the author's view as to the complex nature of the electron and its accompanying waves. *The Macmillan Company, 60 Fifth Avenue, New York.—80 cents.*

PHOTOGRAPHY AT EASE is a valuable little handbook designed to help the photographer, whether amateur or professional, to make better pictures. *Burroughs Wellcome and Company, Incorporated. 11 East 41 Street, New York.—Gratis.*

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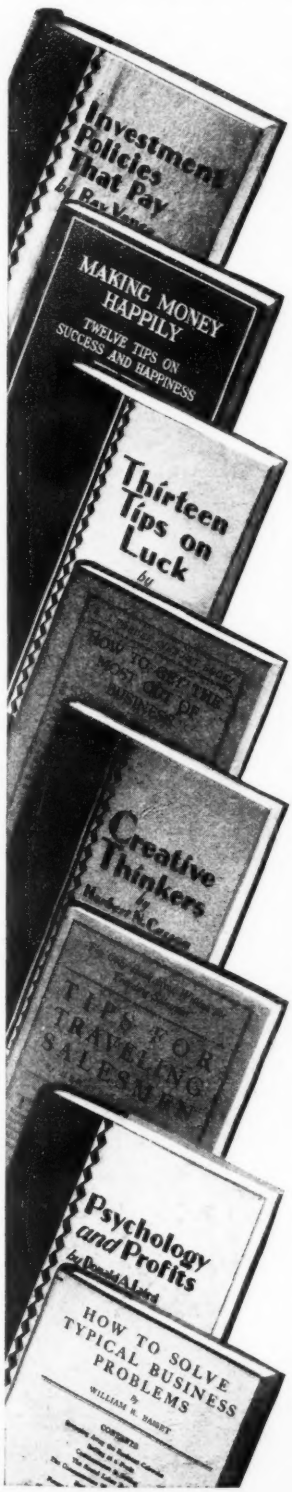
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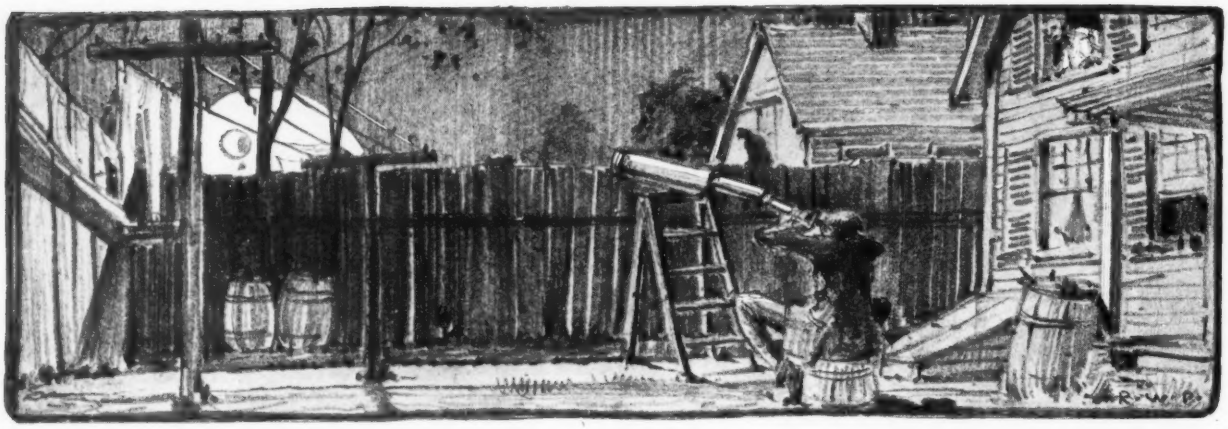

The Amateur Astronomer

THE hobby of the amateur telescope maker received its rebirth at Springfield, Vermont, several years ago, at the hands of a local society of amateurs, "The Telescope Makers of Springfield." We reproduce this month a winter photograph of "Stellafane," the mountaintop clubhouse of that famous society, taken by Oscar S. Marshall, its secretary. Before the mountain which "Stellafane" surmounts was officially renamed Mount Porter the neighboring farmers sometimes called it Breezy Mountain. It is so breezy in winter that the builders of "Stellafane" anchored each of the house's four corners to the Granite State by means of a steel cable let into the rock, so that the building would stay in the state during the Vermont winters. Amateurs who have visited "Stellafane" may behold it now shrouded in white, with the dead grasstops waving above the snowbanks, in the photograph.

ALL three of the other photographs this month are of lads who have taken up telescope making, the hobby which appeals to young and old. The first is Winston Juengst, Box 43, Croton Falls, N. Y., aged 16, who says he has scratches and a turned-up edge on his mirror, but such a good paraboloid nevertheless that the telescope "supplies a real thrill." Juengst is studying astronomy with seriousness. He plans an eight-inch telescope next, but this appears to be contingent on parental permission, as it seems he has also gone in for interior decoration, having redecorated the kitchen, where he made the first mirror, in red of a shade suspiciously resembling that of optical rouge.

Richard W. Aldrich, 626 East Washington Street, Hoopeston, Illinois, aged 17, sends a picture of a four-inch mirror which "took a long time to make but finally came out all right." The total cost was not over seven dollars, he says, the eyepiece being from a "Kopton" optical set. He gets a magnification of 104 diameters.

Reed Knox, Jr., of University Terrace, Deland, Florida, says he "sends us a picture of his telescope so far." It is his third attempt. He dropped No. 1 on a concrete floor and No. 2 refused to polish out, but each time he gains impetus. As he is still no more than 12 years old he has time to beat the 200-inch record about to be hung up. When he grows up he says he expects to be a professional astronomer. Probably Knox is our youngest amateur. Who claims to be our oldest?

LAST month we promised to publish an abstract of an article by Professor A. E. Douglass of the University of Arizona, entitled "Atmosphere, Telescope and Observer." This appeared in *Popular Astronomy* for June, 1897. Our abstract was sent to Professor Douglass with the idea that he might wish to alter it in the light of later experience, but he found nothing in it to alter. After all, however, the matters involved are basic and not a bit different in 1929 than in 1897, and therefore we make them available to our readers. Professor Douglass writes:

"Every astronomer knows that good seeing is not a matter of clouds and that the definition does not become superb merely because the atmosphere has become clear and perfectly transparent; on the contrary a certain amount of haze sometimes improves the seeing.

"Every possessor of a fair-sized telescope, has at hand a means whereby he may study the more obscure atmospheric conditions which accompany good and bad seeing and, at least in some cases, determine whether bad seeing is due to local conditions which may be evaded by moving a few miles, or to general conditions which may require a large change in latitude to correct. The means consists simply in placing the eye directly in the focus of the objective and watching the streams of air pass by overhead.

"The currents cast, as it were, their shadows on the objective and as all the light is concentrated in the focus, the eye can, without changing position, see all the irregularities in illumination which take

"Stellafane," where the amateur telescope making movement took shape

Winston Juengst

place over that area, that is, in the cylinder which extends from the lens to the limits of our atmosphere in the direction of the star. In the case of a planet of sensible diameter this volume is a truncated cone with its smaller end at the objective, instead of a cylinder. These differences of illumination

Richard W. Aldrich

are not real shadows but are condensations or rarefactions of light caused by the refractive power of the air. When, therefore, the objective brings all the light to a focus, the light from certain portions of the waves comes together inside the principal focus, and from other portions outside, so that an eyepiece may be placed behind these foci

Reed Knox, Jr.

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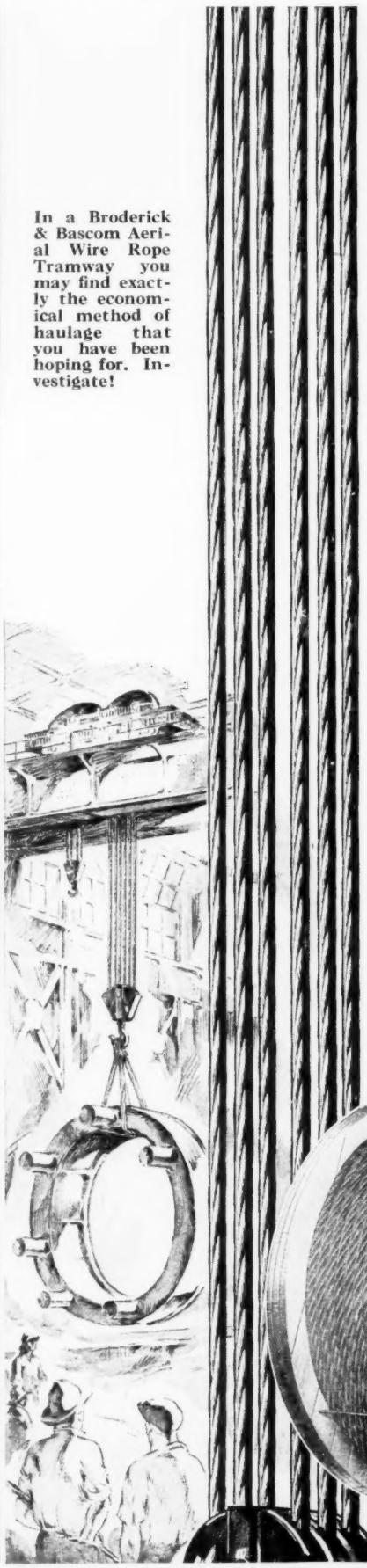

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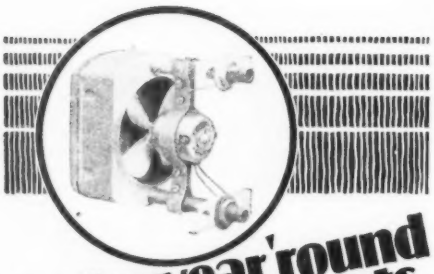

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at proper distances and the waves seen through it.

"The currents of course are usually observed at night but they may be seen in the daytime by using a small diaphragm at the focus to exclude the greater part of the light of the sky. By day they are extremely handsome.

"In order to understand the subject better, let me cite a few familiar cases of the same or similar phenomena. The most ordinary instance is met with in sunlight upon shallow water. There, beneath each rising wave, the light is condensed, while beneath each trough the light is enfeebled. At a certain depth, depending on the character of the waves, the contrast between the crest and the trough is most marked. Upon going deeper the difference decreases, leaving finally only light and dark patches. I conceive the waves in the air to be very similar in their action, although having a different origin and with an extremely slight refractive power. These so-called waves are lines of irregular refraction in the air due to non-uniform density. The irregularities in density are due, I am convinced, to irregularities of temperature.

"Bearing in mind the foregoing facts in regard to the constant presence of air waves which are only a few inches apart and have a measurable refractive power, it is no difficult matter to deduce the conditions under which certain apertures become preferable."

Professor Douglass' discussion will be concluded in next month's number, when he will point out some limitations of the larger sizes.—*A. G. I., Tel. Ed.*

The Heavens in January

By PROF. HENRY NORRIS RUSSELL, Ph.D.

At 11 o'clock: Jan. 7
At 10½ o'clock: Jan. 14
At 10 o'clock: Jan. 22.

At 9½ o'clock: January 29

At 9 o'clock: Feb. 6
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

NIGHT SKY: JANUARY AND FEBRUARY

MERCURY is an evening star when the year begins and may be seen low in the twilight, especially about the 6th when he is farthest from the sun (19° 15′). He then draws in rapidly and passes through conjunction on the near side of the sun on the 22nd. Venus is still a morning star but is so near the sun that she is substantially invisible. Mars is a morning star, rising less than an hour before the sun, and is hard to see. Jupiter is well visible in the evening sky and is due south between 8 and 9 P.M. during most of the month. Saturn is a morning star but can be seen only late in the month, and then with difficulty. Uranus is an evening star in Pisces setting about 11 P.M., while Neptune is in Leo and comes to the meridian between 2 and 3 A.M. in the middle of the month.

The moon is in her first quarter at 10 P.M. on the 7th; full at 5 P.M. on the 14th; in her last quarter at 11 A.M. on the 21st; and new at 2 P.M. on the 29th. She is nearest the earth on the 15th, and farthest away on the 1st and again on the 28th. As she circles the sky she passes Mercury on the 1st, Uranus on the 7th, Jupiter on the 11th, Neptune on the 17th, Saturn on the 26th, Mars and Mercury on the 28th and Venus on the 29th.

Chemistry in Industry

(*Continued from page 76*)

be spot-welded, rolled, drawn, hammered, and formed with ordinary tools. The value of the new metal is about half that of gold.

Chemical Jingles

THE following chemical rhymes by Thomas Stephenson, reprinted from a recent issue of *Industrial and Engineering Chemistry* will amuse anyone who has experimented in chemistry enough to remember that:

1. Silver nitrate, $AgNO_3$, is extremely corrosive and blackens the skin.
2. Calcium carbonate, $CaCO_3$, neutralizes sulfuric acid, H_2SO_4 with the liberation of carbon dioxide gas, CO_2.
3. Potassium cyanide, KCn, is a violent poison.
4. Copper sulfate, $CuSO_4$ comes in bright blue crystals.
5. Ammonium iodide is very explosive.
6. HgCl is calomel. $HgCl_2$ is bichloride of mercury.

Sam put $AgNO_3$
In his ma's perfumery,
Thinking he would make a hit
If he strengthened it a bit.
Now each morning little Sammy
Goes to greet his Coal Black Mammy.

Johnny, feeling life a bore,
Drank some H_2SO_4;
So his father, an M.D.,
Gave him $CaCO_3$.
Johnny's neutralized, it's true,
But he's full of CO_2.

Maudie was delighted when
She found a lump of KCn.
"Daddy's fond of sweets," said she,
As she dropped it in his tea.
Father drank it; that is how
Maud's mamma's a widow now.

Tommy, eager to explore,
Found some $CuSO_4$.
"Nice rock candy," Tommy cried
As he jammed a lump inside.
Doctor pumped him out, it's true,
But Tommy still feels rather blue.

Bobbie, in his careless glee,
Mixed some I with NH_3.
When the stuff was dry and thick,
Bobbie hit it with a brick.
Robert's now in heaven, they say;
At least he seemed to go that way.

Auntie Jane gave Baby Sue
A dose of $HgCl_2$.
Baby's with the angels now,
And Auntie Jane is wond'ring how
A single atom of Cl
Can make such change in calomel.

We Pay For Ashes

AN enterprising coal dealer in New York has been soliciting business with a personal letter that says, among other things: "No joke about it. . . . We're hauling the best kind of coal. . . . It's so low in carbon content that very little ash remains after burning."

Of course, there *is* a joke about it, and it's on the coal dealer. What he meant to say was that his coal is low in mineral

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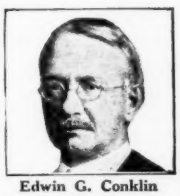
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content. But the general subject of ash in coal is no joke, economically, for millions of dollars are paid in freight to haul the ash which is part of America's coal.

The handling of the worthless ash through the various steps in the distribution and utilization of coal is a large item in the cost of energy delivered at the power plant, says the United States Bureau of Mines in a recently issued bulletin. For example, 1 percent of excess ash in a 50-ton car of coal amounts to 1000 pounds of worthless material per car and entails a loss in transportation cost of one dollar per car where the freight rate is two dollars per ton. If we assume an average freight rate of two dollars and forty cents per ton on the annual production of bituminous coal in the United States during 1927, the transportation loss amounts to a total of 12,426,000 dollars for each 1 percent of unnecessary ash. Consideration of this one item alone shows the economic importance of dirt in coal.

The froth-flotation process, used extensively in the concentration of ores, has been applied within recent years to the separation of coal from ash-forming materials. Briefly, the process involves the agitation of raw coal, 1/10-inch in size or finer, with four to ten times its weight of water and a small quantity of reagent (0.5 to five pounds per ton of dry coal). The reagent with air forms a froth supporting the coal, which floats at the surface and may be removed, while the ash forming materials are largely rejected and remain in the bulk of the water and may be removed separately.

Many reagents may be used including certain oils, soluble organic substances, alcohols, and soaps. The process appears to be particularly applicable to coal that is originally fine or that is crushed to fine size as a part of normal preparation treatment, as for coking.

New Uses for Stellite

STELLITE, a cobalt-chromium-tungsten alloy, has been known as a cutting-tool alloy for many years. Now, due to the development of the Stelliting process, it is finding wide use in a comparatively new field, namely, resistance to wear or abrasion and to combined abrasion and corrosion, says W. A. Wissler, in a recent issue of *Chemical and Metallurgical Engineering*.

The demand for faster production and longer life for all machine parts subject to abrasion has resulted in the development of the hard-facing process, which consists in welding a surface of a wear-resisting alloy to an iron or steel base. This process produces a composite article having a surface of highly specialized alloy capable of resisting abrasion, combined with a steel or iron base that has ample strength and toughness to support the wear-resisting surface.

Such a composite part has great economic advantages as it will wear much longer than a solid steel or iron part and is much stronger and cheaper than if it were made entirely of the wear-resisting alloy. The process also permits the rebuilding of worn parts, thus extending their life indefinitely.

Stellite is being extensively used in many of the large industries wherever severe abrasion is encountered. Included are

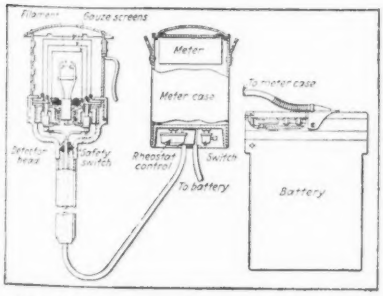
agricultural machinery, rock drilling and digging equipment, and dies for metal-forming operations. The paint industry uses this alloy on grinding and pulverizing machinery. Cement and cement clinker are both ground and conveyed with the help of Stellite. The active surfaces of colloid mills are being hard-faced with this alloy, as is also grinding and crushing equipment of all kinds.

Electric Tester Shows Presence of Inflammable Gas

A NEW electrical tester used for determining the presence and amount of inflammable gases, was described in this department in our June 1929 issue. More detailed information is now available, showing how the detector operates. The device makes use of a heated metallic filament connected in one arm of a Wheatstone bridge circuit. Its use is based upon the fact that the burning of a combustible gas on the surface of a heated filament causes an increase in the temperature of the filament and consequently an increase in its resistance. If, when the bridge is in balance, the filament is exposed to a combustible gas-air mixture, the resultant combustion throws the bridge circuit out of balance, and current flows through the galvanometer, causing a deflection of the needle. The magnitude of this deflection is dependent upon the concentration of the combustible component.

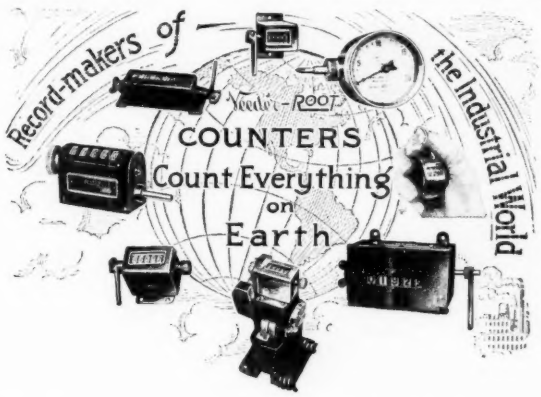
The illustration shows the apparatus partly in section. The detector head consists of a cylindrical metal case or bonnet, in which are three concentric, cylindrical gauze screens of a type similar to those used in flame safety lamps. These afford protection against ignition of an external gas-air mixture.

In operation, for instance in the detection of methane in mines, the operator first turns the switch to heat the filament. Then after a few minutes, when the filament has reached a temperature equilibrium, he connects the meter in the circuit. This is done while the detector head is in a vertical position in pure air. The rheostat knob is adjusted until the meter reads zero, after which the detector may be inserted into the atmosphere to be tested.



Interior mechanism of electrical tester for determining the presence of dangerous gases in the atmosphere

The atmosphere will penetrate the gauze screens and come in contact with the hot filament, whereupon, if any methane be present, the meter needle will immediately move and come to rest at a point indicating the percentage. If the gas mixture is of explosive proportions, the needle will move rapidly back and forth across the upper part of the scale, this oscillation indicating



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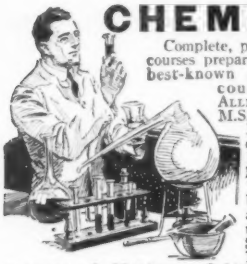

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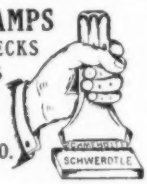

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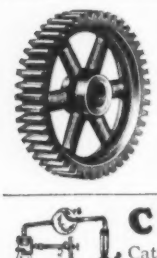

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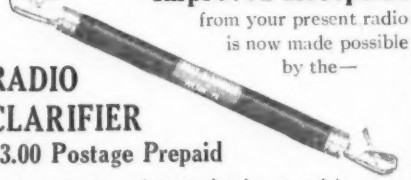

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recurring explosions within the inner screen which cause periodic cooling and heating of the filament.

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Phenol Prevents Mold on Leather

IT is a common experience to find mold on the surface of leather goods that have been stored away, particularly if the storage place is warm and damp. This tendency has caused no little trouble to shoe manufacturers because the growth occurs on sole leather during the process of manufacture.

In efforts to prevent this nuisance, the United States Bureau of Standards chemists have discovered that if the leather is soaked in a 0.2 percent solution of phenol, no mold forms. This simple expedient suggests that phenol or some phenol salt might be used to advantage in dressings for use on leather which is apt to mold in storage or in use, because of high humidity due to climatic or service conditions.

Learning to Use Our Wings

(*Continued from page 73*)

tion is the resistance of the dead propeller. Generally speaking, the propeller runs as a windmill and turns the engine over. The resistance is then much greater than when the propeller is completely stopped, because the power to turn over the propeller and the engine is obtained from the stream of air.

If the propeller is free to revolve and is disconnected from the engine, the resistance is smaller than that of the completely stopped propeller and much smaller therefore than the resistance of the propeller when turning the engine. There are two solutions available: to lock the propeller so that it cannot turn, or to fit it with a "free-wheel" mechanism. The latter and more effective solution is being tested experimentally. It constitutes a pretty mechanical problem.

European constructors are now following American practice in the matter of wheel brakes. One aspect of wheel brakes, which we have often discussed, is the possibility of turning over if the brakes are applied violently and the wheel center is not far enough forward of the center of gravity of the airplane. If on the other hand, the wheel is put well ahead of the center of gravity there is some difficulty in raising the tail at take-off. French designers are now meeting the difficulty by arranging an automatic brake release operative when the tail of the airplane rises. We hope to present shortly a description of this interesting device.

The main objectives of French effort are now safety in flight, the development of

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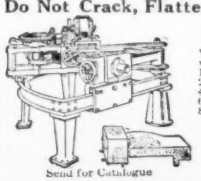

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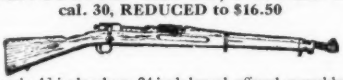

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commercial aviation, and improvement in metal construction. These objectives are akin to those of American aviation.

It is always troublesome and expensive to protect steel aircraft members against corrosion by the use of paints, varnishes, and and similar preparations. The British have apparently solved the problem by the electro-deposition of zinc and cadmium on steamline wires, tie rods, et cetera. They are also using stainless steel in their structures, with much success.

In American practice, the guiding of aircraft by radio has been accomplished by the projection of a radio beam, deviation from the path of which is indicated by a visual or audible signal to the pilot. The British have been more interested in giving an airplane its exact bearings. The system employed consists in having two or more direction-finding stations on the ground, which on demand from an aircraft take a bearing on the aircraft. These stations are usually grouped under a common control where the bearings obtained are correlated and the position of the aircraft determined and transmitted to the pilot. This system offers the objection that it requires the aircraft to be equipped with both a transmitter and a receiver and needs a certain amount of formal signal organization.

Now as a result of considerable research, a system has been developed which requires only a receiver on the aircraft and enables the plane to determine its position wherever it may be, provided only that it is within the range of the transmitter. The system employs on the ground what is termed a rotating beacon. This is a transmitter consisting of a simple loop. This loop is rotated at a constant speed of one revolution per minute. It transmits a characteristic signal when in the north and in the east positions.

If the aircraft pilot receives the north signal from the beacon and notes the time which elapses between the transmission of this characteristic signal and the receipt of the minimum signal, the bearing of the aircraft from the beacon is immediately obtained by multiplying the time in seconds by six. An installation consisting of two such beacons enables the plane to determine its position without having to transmit. The system is simple and requires no preconcerted signal organization.

Such a system might have considerable advantages over the American plan.

Beryllium for Aircraft

AT the meeting of the Society of Automotive Engineers held during the Cleveland Air Races, the possible use of beryllium for aircraft construction was discussed. This is a most extraordinary metal. Its density is only that of magnesium or about two thirds that of aluminum, yet in strength and elasticity it is equal to steel. A 60 percent beryllium-aluminum alloy may have a tensile strength of 60,000 pounds per square inch and beryllium, if used for aircraft construction, has extraordinary possibilities of weight saving. One competent authority estimates that a Ford tri-motor plane could be lightened over a thousand pounds by the use of this new metal. Its main drawback is cost, which is now about 60 dollars a ton. If this can be reduced, particularly by sale of the by-products of beryllium ore, this material may become immediately useful to aircraft designers.

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By Alexandre Dumas

A NEWLY discovered, previously unpublished work by the famous author of "The Three Musketeers." All appreciative readers of Dumas will welcome this publication which fills in hereto unchronicled years; the second part relating his campaign with Garibaldi's "Thousand" in Sicily.

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

"Eskimo Pie" Patent Held Invalid

DESPITE the fact that "Eskimo Pie" had achieved almost phenomenal success commercially, having a marked effect upon the ice cream and confectionery industries, it has been judged unworthy of protection under the existing patent. This decision, rendered by the Circuit Court of Appeals for the Third Circuit, upheld the ruling of the lower court that there was no invention in coating a block of ice cream with chocolate.

The holder of the patent, Eskimo Pie Corporation, had brought suit for infringement against John Levous and Purity Ice Cream Company in the District Court for the District of New Jersey. The defendants admitted that if the patent were valid it was infringed, leaving the court to decide upon the question of validity.

In holding invalid the patent granted to C. K. Nelson (Number 1404539) in 1922, for a chocolate covered rectangular block of ice cream, the court gave credence to earlier references which described the manufacture of "ice cream cannon balls." These confections were round balls of ice cream covered with chocolate in the manner that candies are coated. The appellant contended that the Eskimo Pie coating is a "sustaining and form-retaining casing," unlike the coating used for the "cannon balls" and candies. In the opinion of both courts, this claim was not substantiated and there is no invention in merely changing the shape or form of an article without changing its function, except in a design patent.

In a doubtful case of this kind, the fact that a patented article has gone into general use has great weight, but in this instance it was held that commercial success is an unsafe criterion even of utility and much less of patentability. It was pointed out that such success may be due to extensive and judicious advertising, activity in putting the goods upon the market, large commissions to dealers or the attractive manner and form in which the goods are put up and exposed to the eyes of the purchasers. Moreover, the court decided, when an article is sold under a trademark, commercial success may be due to a large extent to an attractive name used as a catch word.

New York courts are apparently more charitable than New Jersey courts, for in the somewhat analogous case concerning the process for making ice cream lollypops, the genius of the inventor is recognized. In the latter case, the District Court for the Southern District of New York ruled that the Burt ice cream lollypop (Patent Number 1470524) was valid and infringed. The Popsicle Corporation et al had brought suit for infringement against Isadore Weiss, doing business as Goody Frozen Products Company.

Various patents were citied in an attempt to show that the Burt patent was lacking in patentable novelty. One of these was a patent to Goldberg (60136) in which a stick was inserted into candy while the candy was in a warm, soft, sticky condition: upon cooling, the stick became rigidly fixed to the candy. However, the Court upheld the Burt patent, stating, "It is one thing to insert a stick in a warm, soft, sticky substance that by cooling will adhere thereto, and quite another to effect a strong union between a stick and frozen substance." Other prior patents had disclosed a handle of metal and a flexible looped cord frozen into a block of ice cream, but they were held not to anticipate the use of a wooden stick.

Motion to Dismiss With Prejudice Denied

IN the suit of A. C. Gilbert Company *versus* United Electrical Manufacturing Company, in the District Court for the Western District of Michigan, the court denied a motion for dismissal of the bill with prejudice on the grounds that the case must be settled on its merits. Both firms are manufacturers of electrically operated devices, which are used for the same purposes and are sold by plaintiff and defendant in competition. The plaintiff filed a bill of complaint and then sent circulars to the trade and to the defendant's customers, asserting that the defendant's devices were infringements on patents of the Gilbert company.

Later the plaintiff filed suit against one of the defendant's customers in another jurisdiction, and desired for convenience to try the matter at the latter place. With this end in view, the plaintiff filed a motion to dismiss without prejudice the original suit. The motion was opposed by the defendant on the ground that in view of the publication of charges asserting infringement, a prejudice was left in the minds of defendant's customers without opportunity on his part to disprove the charges.

In its decision, the court held that the publicity given the matter must have had a detrimental effect on the business of the defendant. In the opinion of the court, "this effect is of such nature as would not be removed if the bill of complaint herein be voluntarily dismissed. . . . Such damage to defendant's reputation and business standing can only be removed by a judgment of the court deciding the controversy on the merits." The court held also that the defendant cannot use the conduct of the plaintiff as a ground for dismissal of the bill with prejudice while relying on such conduct as a ground for opposing the dismissal of such bill without prejudice.

White Light from Electrified Gases

SINCE George Claude produced light with the first practical electrified gas-filled tube, utilizing neon gas, engineers have been seeking to perfect an optically clear white light of the same type as the red light produced with neon. The principal difficulty has been to produce a gas yielding a white light, having sufficiently long life to be commercially practical. Engineers of Claude Neon Lights, Incorporated, have developed what seems to be the desired white light, possessing the characteristic brilliance of electrified gaseous light without imparting glare or eye strain.

It is contended by the advocates of luminous tubes that the ordinary electric incandescent lamp incurs a waste of more than 75 percent of the electric current, because of the heat that must be generated before the filament provides illumination. In the gaseous tube type of electric light, advantage is taken of the fact that the inert gases of the atmosphere are conductors of electricity, and consequently an electric current can be passed through a gas-filled glass tube without the use of wire filaments. The action of electricity on the gas creates the luminous glow which has become so familiar in advertising displays. This glow can be controlled in density and color.

The new white light is said to render greater visibility with less actual candlepower than is required when using incandescent lamps, with considerable saving in electric current consumption. Because it is a comparatively cold light, it is said to be adaptable to under-water illumination and various cold weather conditions. The new white tubes possess brilliance and intensity comparable with tubes of red, blue, green, yellow, and other colors.

Just the Inventor

AN engineer, explaining the operation of a certain machine in a factory, was very much annoyed by the frequent interruptions of a certain man. Exasperated, the engineer refused to continue and walked away.

"Who is this fellow who pretends to know more than I do about this machine?" he demanded, when he met his employer.

"Oh, he is the man who invented it," was the reply.

Patents in Czechoslovakia

NUMEROUS aeronautical patents have been issued recently in Czechoslovakia, including one (Number 26383) which enables an airplane, in the event it alights on steep ground, to be protected against tilting over. Another (Number 25798) makes it possible to secure the simultaneous release of an airman and parachute by merely pulling a lever, which frees the parachute so that when the airman jumps the 'chute is pulled away from the plane, opening automatically. Patent Number 25809 facilitates the opening of the parachute at the moment when the flyer jumps from the airplane.

According to a report compiled by Dr. Kunzl, Departmental Chief of the Patent Office of Czechoslovakia, the applications for patents received during 1928 numbered

8461 or 698 more than in 1927. The number of new patents granted in 1928 was 3450. Every year sees an increased interest in the protection afforded by patents. Many of the applications come from the United States, which ranks next to Germany in the number of foreign applications received. Electrical machinery and equipment, chemical processes, and various kinds of apparatus are the most popular fields for invention, according to the report of Dr. Kunzl.

As in other parts of central Europe there has been a marked increase in popular interest concerning new technical developments during the past few years, although the world-famous Czech handicrafts are still flourishing, providing a livelihood for thousands of impoverished families. An association known as the Detva is active in keeping alive the peasant customs and folklore of a people who can look back upon a thousand years of history and tradition, and the Red Cross has provided funds for Czech children in the schools to be taught how to make toys, ornamental beads and small wooden figures which find a ready market in Europe and America. The Red Cross hopes to enlarge this work to teach the children to make embroidered bags, laces, and ornamental lamp shades, for which there is a constant demand. In some of the mountainous districts where most of the adults eke out a living as weavers and glass makers, the children have been able to provide themselves with excellent schools largely through the money they have earned by pursuing their native handicrafts.

British Inventor Perfects Message Recorder

LOUIS BLATTNER, noted for his invention of the magnetic steel wire system of recording "talking pictures," which is said to produce records that are virtually everlasting, has perfected a telephonic recording machine which is said to automatically record and file telephone conversations or communications. The record is available as soon as the conversation ends. It is pointed out that telephonic messages can be received and recorded late at night without disturbing friends, or at places of business outside of working hours. The patents are held by the London Blattner organization and the Telegraphic Patent Syndicate of Berlin, which joined forces recently under British control.

Fire Extinguisher Patent Not Infringed

ACCORDING to a ruling issued in the case of Foamite-Childs Corporation versus Pyrene Manufacturing Company, the Laurent patent now owned by the plaintiff has not been infringed by the defendant's apparatus used for the same purpose, which is not constructed with a mixing chamber within the device. The case was an appeal from the District Court for the District of Delaware, in which the plaintiff had brought suit against the defendant charging infringement of United States letters patent 858188 issued to Mr. A. G. Laurent of Russia, on June 25, 1907. As the bill was filed in 1924, only a few weeks before the patent expired, the plaintiff did not seek an injunction.

Although the plaintiff in his suit for infringement of the patent claimed otherwise, the court held that the claims in suit were limited to chemically operated foam entinguishers which, although perhaps not having mechanically complete mixing chambers, nevertheless are constructed with a chamber sufficiently complete to enable the apparatus to operate as described in the patent. In reaching this conclusion, in was held that although the claims not in issue include, in terms, a "mixing chamber," and the claims in issue do not include such terms but state that the substance is mixed, the claims in issue must be limited to include a "mixing chamber" to avoid the prior art. Judge Buffington dissented to this view.

It was also stated that where claims do not specifically call for a "mixing chamber," they may be interpreted to do so when the specification states that a mixing chamber is essential. In his dissenting opinion, Judge Buffington pointed out that the distinguishing feature of both extinguishers is the fire-blanketing foam, that the plaintiff was the only maker in America of such apparatus until 1922, and that the defendant began making and selling foam extinguishers in 1922, two years prior to the expiration of the Laurent patent. The Pyrene company had been previously selling soda and acid extinguishers in competition with the foam-producing apparatus. The proof offered in the suit showed that the older type of extinguishing equipment has been completely superseded by the foam extinguisher. In stating his reasons for believing that the patent should be held valid and infringed, the dissenting judge cited the fact that the Laurent invention is embodied in a generic claim as follows:

"A fire-extinguishing apparatus, comprising a receptacle containing separated gas-producing fire-extinguishing substances and a foam-producing substance which causes the substances to produce a gas-filled foam simultaneously with the evolution of gases."

In centering the case around the mixing chamber necessary for the production of fire-extinguishing foam, the Court of Appeals sustained the decision of the district judge, who had dismissed the bill of complaint on the ground that the Laurent patent was not infringed because the claims in suit must be limited to chemically operated foam extinguishers. Such extinguishers, although perhaps not having mechanically complete mixing chambers, nevertheless are constructed with a chamber sufficiently complete to enable the apparatus to operate as described in the patent. The defendant's apparatus was not so constructed, according to the Court, and consequently there was no infringement. The dismissal of the bill was affirmed.

Sanitary Robot Vends "Hot Dogs"

PATENT 1716266 has been granted to Alexander Flamm of Bridgeport, Connecticut, for a vending machine which cooks and seasons frankfurters, places

Patents Recently Issued

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Pertaining to Aeronautics

LONGERON FOR AEROPLANES—Formed from four metal tubes connected by means of rigid struts and wire diagonals with adjustable tension, the lines of action of stress all passing through the central axis which serves to support the strut. Patent 1731157. Gianni Caproni.

AIRSHIP CONSTRUCTION—Wherein the wings are disposed in somewhat compact form adjacent the propellers thus obviating the additional weight created by outspreading wings, and aiding in lifting the ship which may be automatically righted without aid of the motor power. Patent 1731348. Marshall R. Myers.

AIRCRAFT LANDING—Wherein mechanism, including a hooking device, at the top of the aeroplane is caught by a cable suspended between two captive balloons and the aeroplane subsequently lowered to the ground without being subjected to damaging shocks. Patent 1731091. Harr C. Belleville.

AEROPLANE—Constructed with means under the pilot's control for dropping the engine and gas tank in case of necessity, and releasing parachutes connected with the fuselage so that the plane and its occupants may be brought in comparative safety to the ground. Patent 1733030. Morris D. Rosenblum.

Pertaining to Apparel

ARCH SUPPORT—Embodying a metallic plate interposed between the inner and outer sole of a shoe for holding the inner sole in such form as to embrace the arch and support the metatarsal bones of the foot. Patent 1731106. William D. Moore.

COLLAR PIN—For holding soft or semi-soft collars, wherein the front bar of the pin has a necktie receiving recess which will prevent the necktie from being pushed outwardly, as is the case with a straight pin. Patent 1731163. Stanley L. Gedney.

STRAW HAT CONSTRUCTION—In which a mechanical or non-adhesive means is employed for securing down the pointed projections of straw braids in flat contact with the next adjacent convolution, whereby a lighter and more flexible hat is produced. Patent 1733075. Philip Rosenberg and Albert Jaeger.

Chemical Processes

METHOD OF WATERPROOFING FABRICS—Wherein cloth is given a coating of pyroxylin, which is a solution of nitrocellulose, solvent, plasticizer and gums, on one side, subjected to a finishing action, and treated with a second pyroxylin coating, which leaves it flexible. Patent 1732121. Kenneth B. Church.

ALKALI-METAL COMPOUND OF A SUB-OXIDE OF TITANIUM AND DERIVATIVES THEREFROM—Sodium orthotrititanite—a new alkali metal compound of sodium and titanium in which titanium exists as a sub-oxide $Ti_3 O_5$. One of its forms is dense bluish colored powder unsoluble in but hydrolyzed by water. The formula being $2Na_2 OTi_3 O_5$. Patent 1731364. Foord von Bichowsky.

PROCESS FOR RECOVERING BORAX FROM BRINE—More particularly the brine of Searles Lake, California, whereby it is possible to obtain carbonates of soda in the form of large crystals, easily separated from the mother liquor, and quickly washed clear of adhesive brine. Patent 1733537. Henry D. Hellmers.

Designs

DESIGN FOR A PAPER NAPKIN OR THE LIKE—Patent 79610. Edwin B. Schoonmaker.

DESIGN FOR A FABRIC—Patent 79599. William H. Mayer.

DESIGN FOR A HUB CAP—Patent 79653. George L. Hall.

DESIGN FOR A COMBINED LAMP, ASH TRAY, AND LIGHTER—Patent 79656. Charles W. Hopes.

DESIGN FOR A RADIATOR-CAP ORNAMENT—Patent 79550. George A. Briggs.

DESIGN FOR A RADIATOR CAP—Patent 79718. Fred A. Holloman.

Electrical Devices

ELECTRIC-LIGHT FIXTURE — In two parts, one of which may be secured to the stud at the outlet, the other providing some freedom of movement between the body of the fixture and the part secured to the stud. Patent 1732087. Richard Hammerly.

Of Interest to Farmers

HOG GREASER—Which is simple in construction, yet rugged and durable in use, may be readily charged with grease, and in which a positive feeding of grease against the bodies of the hogs is assured. Patent 1731181. William E. Shimp.

AGRICULTURAL MACHINE — A cultivator or harrow expecially adapted for use with an attachment, to Ford tractors, for cultivating the soil beneath low branches and close to the trunks or main stems in orange groves or orchards. Patent 1731925. Levi C. Hester.

FRUIT-GATHERING DEVICE—Consisting of a pair of cutters and a receptacle, the cutters being so constructed as to be operated by one hand, and automatically sharpening themselves, the receptacle may be readily emptied, particularly adapted for gathering cherries. Patent 1732252. Amasa O. Blue.

Of General Interest

VENTILATING AWNING—A Venetian blind which may be raised and lowered to desired positions, and the slats manually operated and adjusted to various angular positions for any degree of ventilation. Patent 1729928. Charles L. Dabney.

CONCRETE WALL CONSTRUCTION—In which special slabs two inches in thickness are secured in vertical relation edge to edge and locked into reinforced concrete columns poured in place, easier to erect, and cheaper than solid concrete, for certain purposes. Patent 1729293. Charles E. McCartney.

HOLDER FOR GRAPHIC INSTRUMENTS—Adapted for holding a fountain pen or other closely analogous instrument conveniently disposed in an angular position, the holder will accommodate and yieldingly or tensionally hold pens of different sizes. Patent 1730287. Ernest Oldenbusch.

BOOK COVER—Particularly adapted for account books, to protect them from the usual wear and tear, the cover is provided with means whereby a metal plate may be applied to serve as a hard writing pad. Patent 1730244. Rudolf Reinisch.

UNIVERSAL PLUG VALVE—So called because it can be made to replace any type valve, and will prevent leakage or escape of fluid, gas, liquid, etc., no packing being necessary and no extra space necessary in operation. Patent 1730305. George Stancu, Jr.

the "weenie" in a toasted roll which is automatically slit, and transfers the sandwich to a sanitary wrapper which mechanically closes around the contents. The chief claim for the device is that it keeps the food free from dust. The machine is controlled by electricity, and is operated by the insertion of a coin.

Origin of Our Patent and Copyright Laws

DELVING into Colonial and early American history, according to Karl Fenning in a recent issue of the *Journal of the Patent Office Society*, one finds that there was no debate or controversy concerning the patents and copyrights clause of the Constitution. According to Mr. Fenning, the patent statutes and the copyright laws of the United States are based on a section of the Constitution which does not employ either of the words "patent" or "copyright" but reads as follows:

"The Congress shall have power . . . to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

General Charles C. Pinkney of South Carolina played a leading part in having the Constitutional Convention authorize protection for both authors and inventors. As early as 1784, South Carolina enacted a statute for protecting inventions. Prior to this time, according to Mr. Fenning, there had been several states with copyright laws but none that had made provision for patenting inventions. After providing for copyright protection of books, the South Carolina Act said:

"The inventors of useful machines shall have a like exclusive privilege of making or vending their machines for the like term of 14 years, under the same privileges and restrictions hereby granted to, and imposed on, the authors of books."

Of course, it is pointed out by Mr. Fenning, "copyright and invention patent protection was extended to the colonies by the English laws, and the meaning of the words 'patent' and 'copyright' were more or less fixed. The laws of five of the States, namely, Connecticut, Georgia, New York, and North and South Carolina, had definite requirements for publication of copyrighted books in sufficient numbers and at a cheap enough price to satisfy the public demands.

"Those requirements were, of course, impressed upon the patent clause of the South Carolina statute, and apparently became a requirement to manufacture the patented device and to sell it at a reasonable price. Some of the state laws provided that if these requirements for publication and sale were not carried out a tribunal might grant a license to someone else to publish.

"It is significant, therefore, that in framing the Constitution in its final form, the words patent and copyright were not used, possibly lest the power be limited to the particular forms of conditional exclusive rights which were at that time known as copyrights and patents. The words finally chosen for the Constitution seem to allow no limitations on the 'exclusive' right such as requirements for working or compulsory licenses. It seems clear that it would be unconstitutional for Congress to endeavor to provide for either type of limitations in either patents or copyrights."

JOINT FOR CORRUGATED BOXES—Especially designed as a corner connection for a box of the foldable type, to be employed in lieu of connecting the meeting edges with a strip of tape which is the common practice. Patent 1731111. Morris C. Romer.

GLASS PROTECTOR FOR WINDOWS AND DOORS—In the form of a metal strip with reinforcing pad, which may be quickly applied to the surface of plate glass windows for protecting the glass in cases of severe wind storms. Patent 1731114. Martin E. Sparrow.

ROD-SUPPORTING MEANS—For awnings and canopies, a union consisting of rod end receiving sockets for connecting together the sections of an unusually long rod and rigidly supporting and preventing sagging of the same. Patent 1731113. Fred W. Siegel.

RECORDING DEVICE FOR CAMERAS — Which will operate in conjunction with the shutter for photographically registering on a portion of each film or plate certain information, such as time of exposure, and "stop" used, which will appear when the film is developed. Patent 1731198. Frank J. Kawatch.

REFLECTING DEVICE FOR MOTION-PICTURE PROJECTORS—Whereby an adjustable auxiliary reflector, added to the main reflector, will enable the operator to simply and efficiently control the distribution uniformity and intensity of the light with accuracy as it is projected on the film. Patent 1731104. William Mayer.

RING SETTING—Having a mounting with swiveled connection which permits the setting to be reversed to expose different stones, the setting also being hinged between the stones or ornaments so that it may be opened to expose a picture or other enclosure. The inventor has been granted two patents, 1731092 and 1731190. Charles Birnbaum.

TOOTHBRUSH—Having brush head sections which may be converted from a convex surface to a concave surface, or vice versa, the brush head being held by a latching means. Patent 1731751. William M. Neissl.

NURSING BOTTLE—So constructed that air will enter at the bottom instead of at the top thus causing an easy flow through the nipple, leakage being prevented through a valve. Patent 1732126. Joseph P. Gardiner.

COLLAPSIBLE BARREL—Wherein a plurality of hingedly connected sections may be readily disconnected, permitting storage in a limited space, the barrel may be readily assembled or dismantled without the use of special tools. Patent 1732128. Harley A. W. Howcott.

HUMIDIFIER—Constructed to utilize the waste heat from the smoke pipe of a heating plant to warm and vaporize a spray of water for producing the proper moisture into the air of a home or other building. Patent 1732055. William P. Lee.

INTERNAL CONTROL FOR DUMB-WAITER DOORS—Which will prevent the occupants of apartments opening and leaving open the door, which becomes a source of great danger, the door opening only on signal from the janitor that the elevator is at the apartment floor. Patent 1731349. Holger Petersen.

GUARD FOR GUTTERS—In the form of a screen for roof gutters, or eaves troughs, for preventing leaves and rubbish from entering the gutter and clogging the drain pipes, and so preventing the same from overflowing. Patent 1732058. Martin M. Martini.

TYPE CLAMPING ATTACHMENT FOR CHASES—In the form of a bar attached at its opposite ends to one side of the chase, and elements threaded through said bar for clampingly engaging the type, and relieving the chase side of warping strains. Patent 1732074. Andrew B. Weiler.

HIGH-LIGHT STOP FOR CAMERAS—A light stop plate having grouped light openings assembled in polygonal formation with opposite corners of a diagonal of the figure disposed in the longitudinal median line of the plate. Patent 1732051. Carl G. Johnson.

SHOWER-BATH SPRAY—Wherein hot and cold water are delivered simultaneously, through separate pipes, so that the water strikes the body in the form of a hot stream encircled by a stream of cold water, giving a very exhilarating shower. Patent 1733054. Edgar J. Crill.

ENVELOPE OPENER—In which, through the co-operation of two blades, the extreme edge of an envelope is cut away and separated from the body so as to cause the envelope to be opened along an entire edge. Patent 1731413. Richard Glasser.

CORRUGATED ROOFING AND BUILDING SHEET—Comprising a duplex corrugated sheet formed by uniting two separate preformed sheet elements, the outer one being of asbestos cement and the inner of compressed cork-board sections, the two being cemented together by a jointing cement. Patent 1732368. Louis Lane.

EDUCATIONAL DEVICE—Comprising an alphabet display means, having the consonant letters and the vowel letters colorably distinguished from each other, to aid in or otherwise facilitate the teaching of correct spelling and increase the average individual vocabulary. Patent 1732980. Althea S. Mooney.

CONTAINER—Having a restricted tubular member with closure, in open communication with the container, through which material may be removed from the container while preventing too great a surface of the contents being exposed to the atmosphere. Patent 1733889. John Laughlin.

INSECT TRAP—Or catching device, which has conically shaped members open at opposite ends, which will aid in guiding an insect into a chamber, divert it away from the original passage it entered and prevent its escape. Patent 1733818. Carl J. Nordstrom.

CRUTCH—Having a resilient tip or bottom, the resilient features consisting of a spring, a rubber ball and a cylindrical sleeve for holding both the ball and spring in conjunction with one another. Patent 1733430. John L. Shahan.

Heating and Lighting

DAMPER CONTROL—In which a manually operated wheel revolved through a complete revolution will move the damper through a small angular degree to give a minute draft control, and will maintain the damper in any desired position. Patent 1733832. Charles H. Sparklin.

Hardware and Tools

PIPE CUTTER—Having means for advancing the cutter, for cutting pipe or other cylindrical objects, during the act of turning the stock upon such objects, thus, in effect, bringing continuous cutting pressure to bear. Patent 1732160. Richard T. Frye.

CABLE CLAMP—Including a cable-receiving body member having bifurcated portions which are adapted to receive a clamping member which is adapted for threaded engagement to control the tension applied to cables received therethrough. Patent 1732033. Edwin B. Snead.

NUT LOCK—Which may be applied to any standard bolt, thereby dispensing with specially constructed bolts, means being provided and actuated by the rearward rotation of the nut for firmly locking the same against such rotation. Patent 1731337. Sebastian Giovannini.

PIPE WRENCH—Which has a positive and instantaneous grip, great freedom of release, and is adapted to be instantaneously reversed without taking it off the pipe, a locking notch preventing any accidental loosening from the pipe. Patent 17456. (Reissue.) Oscar Johnson.

CABLE FASTENING—A strong and durable fastening device which will securely anchor a cable to a post and permit the former to be subjected to a maximum strain without becoming detached, yet in case of breakage of any one of the elements they may be quickly replaced. The inventor has been granted two patents, 1732053 and 1732054. Omar K. Landis.

ADJUSTABLE RATCHET WRENCH—Adjustable to suit a variety of objects such as nuts, wrench sockets, square or other bars, is adaptable to all the standard sizes of sockets so that it may be regarded as a universal handle. Patent 1733012. William F. Henderson.

Machines and Mechanical Devices

GRINDING MACHINE—Particularly adapted for boring or reboring the cylinders of engines, which can be secured to the cylinder, by the same bolts which secure the cylinder head, and attached in place of a cylinder head. Patent 1729288. Frank S. Harrell.

ALARM MECHANISM FOR CLOCKS—Which first renders operative a relatively mild alarm and signal light to gently awaken the sleeper, and subsequently sets into operation an alarm bell, the device may be conveniently associated with many conventional alarm clocks. Patent 1730276. August J. Kollman.

TIRE - PATCH - CUTTING APPARATUS—A belt-knife splitting machine, which facilitates the making of tire patches from old and used tires, and forms the patches uniformly, accurately and quickly, and insures patches of perfect shape for tires or other articles. Patent 1731132. Adolph R. and Charles Hendry.

PUMP PLUNGER—Adapted for pumps employed in mines for removing water and other liquids, wherein the main part of the plunger is formed of vitreous material and the metal parts formed of acid resisting metal. Patent 1731147. Fred W. Moyer and Frank J. Reninger.

DERRICK CAP—Which will adjust itself to the pull of the guy cables without causing any binding between the cap and gudgeon pin, will permit the mast to swing in any direction, and may be repaired without dismantling. Patent 1731121. Edward P. Bathurst.

DRILL STEM—For use with well equipment, will stand a maximum of vibration, comprises telescoped tubes and a threaded head at each end, each having connecting means with the drill stringer and the drill bit. Patent 1731171. Jesse P. Miller.

CABLEWAY—An overhead travelling system that is capable of carrying loads and depositing them at any point within a prescribed three dimensional space, particularly adapted for use in the construction of dams and bridges. Patent 1729964. Verne L. Peugh.

DISPLAY CASE—Having mechanism whereby lead pencils or other articles are attractively displayed and readily accessible for purposes of sale, or other authorized purposes, yet reasonably safe against removal by an unauthorized person. Patent 1732173. Sverre R. Svendsgaard.

CUTTING MECHANISM—The inventor has been granted two patents, for fabric cutting mechanism, one for cutting strips on the bias of predetermined length and width, and for protecting the cutter, the other having a cutter arranged for cutting a piece of fabric at any desired angle, within a certain range, into strips of various lengths and widths. Patents 1732148 and 1732149. William R. Barrett.

HOISTING AND TRANSPORTING DEVICE—A structure which is adapted to be set up over a hole communicating with a basement for hoisting cans of ashes or refuse from the basement and for transporting the loaded can to a disposal point. Patent 1732153. Delma C. Crichton.

FILLING MECHANISM—Adapted to dispose measured amounts of liquid, such as syrup, in bottles, the capacity of the measuring means may be varied to the slightest fraction of an ounce and the desired quantity disposed in each bottle, irrespective of the temperature effect upon the liquid. The inventor has been granted two patents, 1731464 and 1731465. James Kantor.

METHOD OF COATING PIPES—Whereby the outside is conveniently covered with a waterproofing composition, such as bitumen or asphaltum, applied hot, and which cools to form a complete coating to protect the pipe from injurious contact with the earth. Patent 1733006. Hugh M. Cook and Lorlys R. Rogers.

SOD CUTTER—A machine adapted to be drawn over sodded ground, having means for cutting the sides of the sod and beneath the same to a desired depth, and a knife for severing the sods in given lengths. Patent 1732972. Michael J. Kniffing.

PRINTING-PRESS ATTACHMENT—For stock feeding tables, whereby automatic suction shoes are prevented from bearing weight on the uppermost sheet and pressing it down upon the next sheet, designed for "Miehle" presses but may be slightly changed to fit other presses. Patent 1732653. Boliver Margwarth.

ELECTRIC SAND SPRAYER—A spraying machine conveniently manipulated by hand, in which sand is discharged into a conduit wherein a forced draft thoroughly separates the sand, a tapered nozzle discharging the sand in a fine spray. Patent 1732655. Kurt A. Peters.

Medical and Surgical Devices

RENEWABLE DENTAL SLAB—In the form of a renewable surface which may be removed and discarded and a fresh surface exposed for the next mixing operation, thus saving time in cleaning the customary glass slab. Patent 1729292. John J. McCarthy.

BACK WASHER—Which embodies means for containing a detergent or soapy solution which will reach the back or other parts being washed, may also be readily converted into a medical appliance for a bandage, or poultice holder. Patent 1730299. Adam A. Sanders.

Prime Movers and Their Accessories

ROTARY ENGINE—Having an intermittent coupling between the rotors and drive shaft which admits of the operation of the motor in either a clockwise or counter clockwise direction by employing ignition devices at two points. Patent 1732995. Traugott Tschudi.

CHOKE CONTROL FOR CARBURETORS—Adapted to engage the usual actuating rod for the choke valve permitting ready actuation, but which will cause the rod to travel slowly after release as the valve is opened by the usual spring. Patent 1732969. Stuart G. Garrett.

PISTON RING—For internal combustion engines, having spring means retained in tubular members within the piston adapted to exert a steady outward pressure thereby fitting a wide range of cylinder diameters and automatically compensating for wear. Patent 1732978. Thomas O. McLendon and James H. Irving.

Pertaining to Recreation

FISHING ROD—Of the extensible type, comprising a hollow cylindrical handle and a tapered body portion capable of adjustment, and having means for firmly clamping the parts at any desired length, when retracted may be conveniently carried. Patent 1731173. William E. Pope.

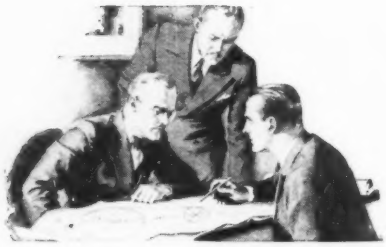
MERRY-GO-ROUND—So constructed that children can exert a push or pull to turn the revolvable portion of the structure, the arrangement being such that a number of children can stand on a platform and operate the device. Patent 1733005. Herbert D. Clayton.

Pertaining to Vehicles

MOISTURE TRAP FOR AUTOMOBILE CRANK CASES—For trapping the accumulated waters of condensation which settle at the lowest point in the crank case, whereby the water may be drained off to prevent stoppage by freezing. Patent 1729978. Edward T. Barron.

TOP FOR AUTOMOBILE RUMBLE SEATS—In the form of an attachment, characterized by its simplicity, ready adaptability, removability and collapsibility, to permit it to be stored in a relatively small space when not in use. Patent 1729919. Otto Aitenbach.

VEHICLE BUMPER—Having a light reflecting element by which light rays from the headlights of an approaching vehicle will illuminate the bumper, thus enabling approaching vehicles to safely clear each other, notwithstanding glare from the headlights. Patent 1729274. Stephen P. Millar.



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